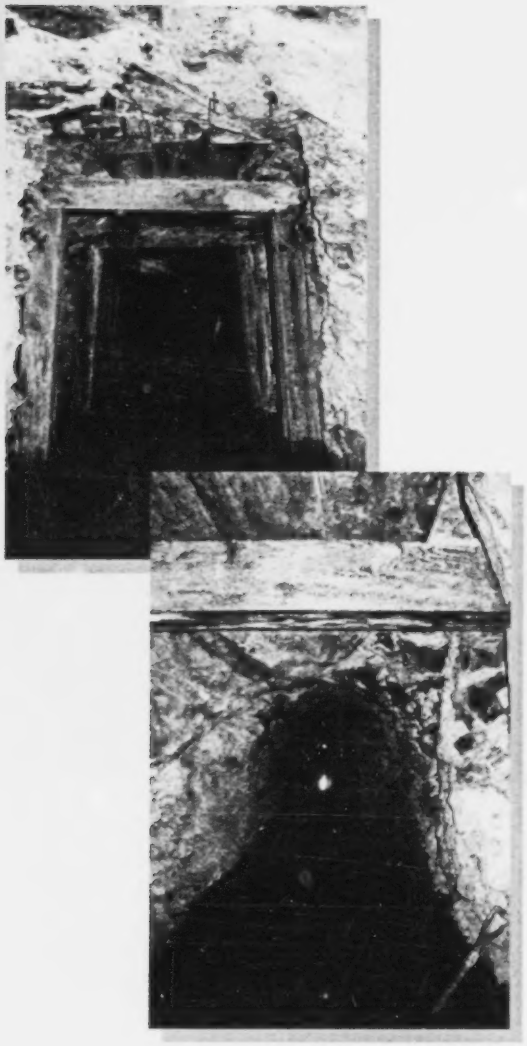
Ministry of
Sustainable Resource
Management

BRITISH COLUMBIA

Britannia Mine Remediation
3250 Level
2004 Hydraulic Communications Test



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3250 Level
2004 Hydraulic Communications Test

BC Ministry of Sustainable Resource Management

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1 Introduction

1.1 General

This document presents the results of a test procedure that was carried out at the Britannia Mine Site in 2004 to verify the hydraulic conductivity between the 4100 tunnel and the 3250 portal. Figure 1.1 locates the key components of the Hydraulic Communication Test (HCT), which was carried out as a first step towards evaluating the possible use of the 3250 tunnel as a potential overflow for the mine reservoir. The test was conducted under the supervision of SRK/Klohn Crippen and began on July 6, 2004 and concluded on September 28, 2004.

The test was carried out in accordance with procedures described in *Britannia Mine Remediation Project – Approval Request for Discharge in Conducting the 2004 Plug Test*, prepared by Golder Associates Ltd., July 26, 2004 and the *4100-3250 Tunnel Hydraulic Communication Test Plan*, prepared by SRK-Klohn Crippen, August, 2004. Approval AE-17688 for Effluent Discharge to Howe Sound from the test was issued by the BC Ministry of Sustainable Resource Management (See Appendix I).

1.2 Terms of Reference

The primary purposes of the HCT program were:

- To determine if any blockages exist in 2700 raise / 3250 tunnel that would prevent the use of these mine passages as a mine spillway in the event of operational issues or natural events in the mine.
- To determination the elevation of the floor in 3250 adit where the raise from the 4100 tunnel intersects (spill point).

Secondary objectives (Mine filling aspects) of the 2004 test were:

- To verify that no changes in mine storage volume occurred since the 2002 plug test;
- To monitor the mine water flow vs. resistance relationship for changes that may impact future collection of mine water via the 4100 tunnel; and
- Comparison of changes in contaminant concentrations resulting from the flooding of the workings between the 2002 and 2004 mine fillings.

1.3 Acknowledgements

The plan for this work was developed by SRK Consulting and Klohn Crippen Consulting at the request of the Golder Associates, Managers of the Britannia Mine Remediation Project. Peter Healey of SRK was Project Manager for the Hydraulic Communications Test. Operation of the mine reservoir during the test was conducted by Terry Johnson, Mine Manager. Monitoring of the reservoir levels and flows was done by Graham Parkinson of Klohn Crippen Consultants and Pat Bryan, an associate Hydrologist. Kirk McMillan of Remote Environmental Inc monitored the 3250

level. Kelly Sexsmith of SRK Consulting conducted the water quality monitoring and sampling programs.

1.4 Document Organisation

Section 2 provides background information on the test. Section 3 summarizes the planning process, preparations for the controlled spilling from the 3250 portal and an overview of the operational details of the Hydraulic Communication Test. Section 4 presents the results of the test and a discussion of the results is provided in Section 5.

2 Background

A key factor of the proposed water treatment plant at Britannia is the need to utilize the underground workings as a water storage reservoir. However, the dynamic nature of the underground workings and the potential for the occurrence of blockages within the mine raises the question of how water will escape from the mine if a blockage occurs.

With large amounts of wood and other debris in the mine, it is possible that the intakes of the pipes may become obstructed, despite the existing timber grid debris barrier originally installed upstream of the pipe intakes. During the period that Copper Beach Estates managed the 4100 plug, the main stainless 10-inch pipe through the 4100 plug became blocked with debris and required emergency action to clear the pipe before excessive pressures built up.

Other possible scenarios include the potential collapses or blockages in the tunnel upstream of the 4100 plug. It has been well documented that there are accumulations of debris in the 4100 tunnel that are believed to have resulted from the 1974 mud rush from the mine. The 1978 construction of the 4100 level plug was constructed following this mudrush.

The configuration of the mine includes a main ore pass raise from the 4100 level tunnel, located upstream of the 4100 plug rising to the 3250 level as shown on Figures 2.1 and 2.2. The raise continues up past the 3100 level to the 2700 level as shown in Figures 2.3 and 2.4. This raise makes its first connection to the surface via the 3250 portal, some 266m above the 4100 level. Confirmation of the hydraulic conductivity between the 4100 and 3250 tunnels was the primary objective of the test.

3 Methods

3.1 Planning and Logistics

The procedures implemented during the mine filling and HCT closely followed the procedures proposed in the HCT plan issued by SRK/KC in August 2004 (SRK/KC, 2004) and the Permit AE-17688. (Appendix I)

3.2 Mine Filling

Filling of the mine commenced with the closing of the 4100 plug valve on July 6th, after the post freshet outflow had dropped to 210 l/s as shown on Figure 3.1. This figure also shows the inflow tests completed during the filling stage. These were done by balancing inflow and outflow at the plug by adjusting the valve opening until hydraulic transients disappeared and a stable outflow equalling the inflow was obtained.

The test schedule was planned to allow the most controlled filling of the mine possible as the water level neared the expected 3250 spill level. Optimum conditions for filling usually occur during the low inflow summer and early fall months. Weather conditions experienced during the program were almost ideal, with generally low rainfall resulting in inflows mainly from the relatively steady supply of mine groundwater.

The filling of the mine to just below the estimated spill point was achieved by September 26th, 2004 leaving sufficient time before the normal heavy fall rains to allow a controlled drain down with a return to normal reservoir levels by early November. The controlled release of water from the 3250 adit occurred on September 28, 2004 and the draindown began the same day.

3.3 Preparations for the Hydraulic Communication Test

All of the improvements and preparations proposed in the HCT plan were completed during the filling phase and before the test began.

This work included completion of calibrations to the 4100 plug and tunnel instrumentation. It also included upgrades to the components of the alternate drainage systems involving modifications to the sandbag dam in the 4100 tunnel, repairs to the 4150 drop box and the wooden flume. To prevent tidal water backing up during mine draindown, rubber plugs were installed to block the connection to the Fan Area storm drain.

The 4150 water level height sensor was moved further into the 4150 tunnel to a point upstream of the sand bag dam to remove the effect of water inflow from the raises during rainstorms. Periods of heavy rains had previously caused the sensor to indicate only the high level of water between the

sand bag and timber dams, rather than the actual 4150 water levels of interest in monitoring the mine drainage level.

Preparations completed at the 3250 portal (see Figure 3.2) consisted of the installation of an accurate Thalimedes float gauge level sensor (chosen due to mm resolution and high stability) and a Freewave radio remote telemetry modem and antenna for monitoring the 3250 pond level as proposed. Raising of an existing permeable earth berm (muck dam) at the 3250 portal with sandbags was completed as well as the construction of a short temporary pipe spillway from the pond in case of excess flows from the portal.

A notification, advising residents of the Hydraulic Communication test and mine filling, was posted in the community before the test began. Copies of the Emergency Response Plan were made available at the Britannia Mine office and also distributed to the major stakeholders in the area.

3.4 Modeling of Test Hydraulics

Modelling of the time for water to travel the length of the 3250 tunnel slope, prior to the test, suggested that travel time would be in the range of 45 minutes to 4 hours, depending on the nature of any blockages, restrictions or semi permeable impoundments formed by debris along the tunnel. It was believed that the travel time would also depend both on the size of the potential impoundments and on the amount of water currently stored behind these obstructions. This suggested that comparing several spill tests in succession for changes in travel time would indicate if any significant amount of water had accumulated behind tunnel obstructions.

3.5 Criteria Used for Detection of Hydraulic Communication

Due to safety concerns surrounding a possible mud rush from the 3250 tunnel, no staff were allowed in the area of the 3250 tunnel portal during the test. Changes in water level just inside the 3250 portal, which would indicate a flow from the tunnel, were monitored remotely from the Britannia townsite Mine Manager's Office.

3.6 Details of the Hydraulic Communication Test Procedure

The data recorded by both the 4100 plug and 3250 was available on a second by second basis via telephone modem from the plug and via radio modem from the 3250 pond. Downloads were made of the complete minute data registers each hour, resulting in flow and level data covering the entire duration of the test. This information was compiled into excel spreadsheet format with common time bases. Synchronization of the time bases was done before the test began.

The filling rate of the mine reservoir was reduced at the peak of the filling by opening the 4100 plug valve as necessary as to ensure that the level approached the lowest possible (estimate minus maximum expected errors) potential overflow level on the morning of September 27th, the planned date for the commencement of the intensive monitoring for the HCT.

On September 27, 2004, mine levels slowly rose between 7 am and 7 pm, and reached 266.1 m above the 10-inch pipe without any observable change in the 3250 portal pond level. Based on mine plans, the estimated height to the lip level of the 2700 raise / 3250 tunnel intersection was 266.0 m (Figure 2.2). It appeared that due to the uncertainty in the estimated lip elevation, no spill from the 3250 had occurred during the filling on September 27, 2004.

To avoid the risk of spilling in the dark, it was decided to lower the mine level for the night and return to continue the next day.

Early the next morning, on September 28, 2004, the 4100 plug valve was carefully adjusted to bring the water level to where it had stopped the previous evening. No change was noted in the 3250 level until 10:30 am. The 3250 pond level had remained constant at 264.764 m above the plug for several days but at 10:30 am it increased by 1 mm initially and then gradually increased until 11:30 am when the water level in the pond at the 3250 portal reached a height of 264.812 m above the plug, a rise of 48 mm. A decision was then made to stop the rise of water in the 4100 to limit the potential spill from the tunnel portal. The 3250 pond level continued to rise as water made its way down the tunnel until 1410 hours (a total potential spill time of 240 hours and minutes) when the 3250 pond level began to decline from a peak of 264.915 m above the plug. Thus the highest rise in the 3250 pond level was 151 mm, 50 mm short of the initial 200 mm set as a target criteria for a spill in the test plan. As the rise in level was clear and unambiguous, it was decided to curtail the filling at a lower level to avoid spilling any more water than was necessary.

To provide more data to assist with estimates of travel time it was recommended by SRK/KC, in consultation with Golder Associates to repeat the spill test, and verify that the results were repeatable.

The 4100 valve was closed again at 1449 hours. As the level in the mine core had not changed appreciably since the first spill test, the level quickly rose past the spill point and the second spill test began. Due to the continual seepage through the muck dam, the 3250 portal pond level had continued to decline to 264.843 m above the plug, until 1711 hours when the water from the second spill test began to appear causing the pond level to begin to climb again. Once the 3250 pond level had risen to 264.904 m above the plug (61 mm higher than first detection of rise in level), it was decided to open the 4100 valve and begin the draindown, terminating the Hydraulic Communication Test. After opening the valve, the pond water level at the 3250 portal continued to rise to a peak height of about 265.05 above the plug as shown on Figure 4.1.

3.7 Water Sampling Program

3.7.1 Overview

Discharges from the 3250 portal, and some key locations in the receiving environment were monitored before and immediately after the mine reached the spill point at the 3250 level to record any impacts. The 4100 discharges were monitored on a frequent basis during the drain-down phase

of the test. The objectives of the monitoring were: 1) to fulfill the requirements of the Effluent Discharge Permit Approval AE-17688 (Appendix I); and, 2) to obtain additional data on the effects of flooding and storage within the mine workings on the discharge chemistry.

3.7.2 3250 Discharges

The 3250 discharges were monitored on June 3 (prior to the test), August 13 (during the filling period), September 28 (during release of the second pulse of water), and September 29, October 2 and October 5th (immediately following the HCT test).

Field pH, conductivity, redox, temperature and flow were measured during sample collection. The samples were submitted to PSC Analytical Services for analysis of pH, specific conductivity, total suspended solids (TSS), total dissolved solids (TDS), acidity, alkalinity, hardness, sulphate, and total and dissolved metals by ICP-OES[1].

3.7.3 Receiving Environment

Four key receiving water stations, including Mineral Creek upstream of the 2700 portal, Mineral Creek upstream of its confluence with Britannia Creek, Furry Creek upstream of the highway bridge, and Britannia creek at the Townsite Bridge were monitored in mid-August (during the filling period), on September 28th and/or 29th (immediately following the HCT test), and on October 5th (one week after the HCT test). The 3100 level discharge was sampled in mid-August, and field readings were collected during and immediately after the plug test.

It should be noted that all of the flows in Mineral Creek upstream of the 2700 level were being directed into the Britannia Townsite water supply line during this period. Therefore this station does not represent a true upstream sample. Observations of flow in Mineral Creek adjacent to the 3100 portal indicate that flows from the 3100 portal contributed most of the flow in Mineral Creek upstream of the 3250 portal.

3.7.4 4100 Drainage Chemistry

The 4100 drainage chemistry was monitored during an inflow test in mid-August and then on a frequent basis[2] from September 28, 2005 when the draindown phase of the test commenced to the end of October when water levels in the mine were below 40 metres. Starting in early November, sampling frequency was reduced to once per week until the chemistry returned to pre-test levels.

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[1] The June 3 sample was not submitted for alkalinity. The August 13th sample was not submitted for TSS, TDS, acidity, or alkalinity.

[2] Initially, this comprised daily field readings, laboratory analyses of copper every other day, and a full suite of analyses every fourth day. After the peak in concentrations passed on October 14th, this was reduced to field readings every other day and a full suite of analyses every fourth day.

The 4100 sampling arrangement was described in detail in the 2002 plug test report (SRK 2003). In brief, a 1.25 inch diameter polystyrene water line conveys water from behind the plug to a location immediately outside of the workings at a flow rate of approximately 0.5 L/s. This provides a more convenient sampling location and reduces the potential for contamination of the samples that could result from adverse conditions inside the mine.

Field pH, conductivity, redox and temperature readings were recorded and unpreserved samples were taken to the site office for field colorimeter readings using a HACH test kit. Samples were collected and submitted to the laboratory for analysis of dissolved metals (partial suite), or pH, specific conductivity, total suspended solids (TSS), total dissolved solids (TDS), acidity, alkalinity, hardness, sulphate, and total and dissolved metals by ICP-OES (full suite).

4 Results

4.1 Determination of 3250 Tunnel HCT Water Travel times

Results of the HCT are presented on Figure 4.1. The time lag recorded between cessation of filling and peaking of the 3250 level pond water level in each test in the was; 2 hrs 30 minutes in the first spill test, and 2 hrs 15 minutes in the second test. The slightly shorter time for the second test was attributed to a small storage volume as a result of low obstructions across the floor of the tunnel. During the first spill test these volumes may have had to have been filled, resulting in a longer apparent travel time for the first test, relative to the second test, during which the volumes would have been already filled.

4.2 Hydraulic Connectivity

The test provided clear evidence that water is able to pass between the 4100 raise and the 3250 portal.

Both the first spill test and the second spill test were used in determining exact spill levels. The levels determined for the lip for each spill test were very similar.

The second spill test also confirmed the travel time estimate derived from the first spill test (used to back project to the level at which the first and second spills occurred).

During the two spill tests, the appearance of water at the 3250 portal was signalled by rises in water level that showed similar peaks in the water level on both occasions.

The exact times of the spills from the raise into the tunnel were not directly detectable or observable. Instead, in order to use the data record to determine the elevation of the spill level for the lip between the 4100 raise and the 3250 tunnel it is necessary to compare the 3250 pond level curve and the 4100 filling record, using the estimated water travel time lag.

During the first spill test, the first indication that water level was changing in the 3250 pond level occurred at 10:05 am. As the travel time obtained from the interval between cessation of filling and commencement of a drop in pond level was 2 hrs 30 minutes, this lag could be used to look back at the 4100 filling curve to establish the level at which the spill commenced. For the first spill test, this level was 266.28m. The second spill test indicated a level of 266.32m, the average of these is 266.3m.

The HCT program has thus established that the density corrected elevation (see Section 4.3 for density correction details) above the pressure sensor at which spilling commences is 266.30 m +/- 0.2 m (corresponding to a non-density corrected gauge indication of 267.27 m). The uncertainty in the result is due to the steps in the digitized pressure reading.

The use of any change in the rate of rise of the 4100 as a method of determining the elevation of the lip between the raise and the 3250 tunnel was not practical. This was because of the limited observed resolution of the 4100 pressure sensor steps (about 0.20 m) combined with the slow natural filling rate of the mine (10 cm/hr) during the test period.

4.3 Accuracy of HCT Determination of Raise Lip Elevation

A secondary result of the HCT was the verification of the density and salinity model used to convert pressure to elevation in the mine. Based on the close agreement of the estimated height of the lip above the plug of 266.03 m with the observed height of 266.3 m, the in-situ average column density of 1.0029 (used to correct the indicated pressure elevation) as determined by lab density, salinity and temperature estimates and water compressibility data appeared to be fairly accurate.

4.4 Water Quality Monitoring

4.4.1 3250 Discharge

Water quality results for the 3250 discharges are summarized in Table 4.1, with complete results provided in Appendix II. The results indicate slightly elevated total aluminium, copper, iron, and manganese concentrations in June and August 2004, and slightly elevated dissolved iron, manganese and zinc concentrations in August 2004 (i.e. prior to the HCT test). The August sample was collected within a few weeks of construction of the overflow pipe, and total metal concentrations may have been affected by this activity.

Alkalinity and pH levels decreased, and concentrations of sulphate, and dissolved and total aluminium, cobalt, copper, iron, manganese and zinc increased significantly in the samples taken during and after the HCT test, but had returned to pre-test levels 5 days later. The increase was gradual, with peak concentrations observed 1 day following the HCT test. This likely reflects dilution by the relatively large pool of relatively clean water stored behind the debris pile at the portal. The dilution provided by this water helped to ensure that concentrations in the discharge were well below those observed in the 4100 level drainage.

Table 4.1: Water Chemistry of 3250 Discharge

	Date	pH s.u.	TDS mg/L	Acidity mg/L*	Sulfate mg/L	Ca mg/L	Mg mg/L	Al mg/L	Cd mg/L	Cu mg/L	Fe mg/L	Mn mg/L	Zn mg/L
Pre-filling	June 3, 2004	7.7	142	1	50.4								
Filling	Aug 13, 2004	7.7			54.8	36.9	1.56	< 0.02	< 0.002	< 0.005	0.056	0.044	0.086
Test	Sep 28, 2004	7.1	212	2.9	123	54.9	2.93	0.098	0.00307	0.0143	0.797	0.278	0.296
Post Test	Sep 29, 2004	4.0	350	26.5	228	74.8	5.03	2.89	0.0147	0.281	1.13	0.493	1.41
	Oct 3, 2004	7.0	190	2.4	73.3	46.2	2.34	0.004	0.00086	0.0019	0.014	0.078	0.179
	Oct 5, 2004	7.4	150	2.1	67.3	41.9	2.02	0.01	0.00117	0.0034	0.013	0.067	0.148

4.4.2 Receiving Environment

Water quality results for the upstream and downstream locations in Mineral Creek, the 3100 portal, Britannia Creek and Furry Creek are also provided in Appendix II.

As mentioned previously, all of the water from Mineral Creek upstream of the 2700 portal was directed to the Britannia Townsite water supply during the plug test, and therefore does not represent conditions upstream of the 3250. Results from this station indicated generally low concentrations of all parameters, i.e. within the range observed in earlier sampling programs.

Water from the 3100 portal, which is below the water supply intake on Mineral Creek, was contributing most of the flow to Mineral Creek during late summer and early fall. Results from the August 2004 indicated this water has a neutral pH, and slightly elevated concentrations of sulphate, copper, iron and zinc. Field readings during the HCT test indicated pH and conductivity readings during and after the HCT test were similar to laboratory readings from the August 2004 sample, suggesting that the 3100 drainage chemistry was reasonably constant.

Results for all samples collected in Mineral Creek just prior to the confluence with Britannia Creek (i.e. below the 3250 portal) were within the ranges observed in historical monitoring at this station, and similar to concentrations observed in the 3100 drainage, indicating that any impacts to Mineral Creek were minimal.

Results for samples collected from Britannia Creek at the Townsite Bridge were generally lower than historical data from this location, likely reflecting a reduction in the rate of copper release from sediments contaminated by historical discharges. Results for samples collected from Furry Creek above the highway bridge were within historical ranges.

4.4.3 4100 Drainage Chemistry

A complete set of results for the 4100 drainage chemistry are provided in Appendix III. The data are summarized in Table 4.2 and Figures 4.2 and 4.3.

As evident in the figures, the pH decreased, and concentrations of most parameters increased approximately two weeks following the peak in water level. These changes in concentration reflect dissolution of stored oxidation products in the workings. Low pH and elevated sulphate and metal concentrations lasted for a period of approximately three to four weeks, generally corresponding to the release of stored water from the mine. However, elevated concentrations generally persisted for a few weeks following the final draindown, either reflecting seasonal variations in the flow through conditions or continued release of oxidation products as water held in any fine sediments in the workings was released.

Other interesting features in the data are summarized as follows:

- Although the pH was lower in the flooded mine water, pH's rarely decreased below 3.1, and were lowest when high iron and reducing conditions were observed in the drainage. This suggests that there is a lower bound on pH in this system, for example buffering caused by dissolution of ferric hydroxide sludges.
- Iron showed the most dramatic response to the flooding, with concentrations increasing from a pre-test levels of less than 5 mg/L to a peak of 120 mg/L. This was accompanied by a downwards shift in redox. Equilibrium modelling of similar data from the 2002 plug test indicated that the iron during this period was present primarily as the ferrous form (SRK 2003).
- Zinc and cadmium concentrations were strongly correlated with each other, and appeared to decrease slightly during the test, suggesting that the main sources of zinc and cadmium are above the flooded zone of the mine. This is consistent with geological reports for the site.
- Total suspended sediment concentrations in the mine water were generally low throughout the tests. However, slightly elevated TSS (30 to 50 mg/L) occurred in a few samples between October 8th and 28th, which was during the period where low redox conditions occurred. These samples appeared to be relatively clear at the time of sampling. The high TSS values therefore could have been due in part to oxidation of the samples and precipitation of ferric hydroxide during or after sampling.

Table 4.2: Water Chemistry of 4100 Discharge during Draindown

	Date	pH	TDS	Acidity	Sulfate	Ca	Mg	Al	Cd	Cu	Fe	Mn	Zn
		s.u.	mg/L	mg/L*	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Draindown	Sep-28, 2004	3.8	2250	138	1470	448	68.3	12.1	0.094	14.1	7.72	5.75	21.5
	Sep-30, 2004					473	80.1	22	0.131	40.8	23.2	6.87	29.7
	Oct-02, 2004	3.6	2580	223	1570	480	80.4	22.2	0.134	29.9	7.59	6.89	28.6
	Oct-04, 2004					485	92.9	33.7	0.121	37.4	38.1	7.64	26
	Oct-05, 2004	3.2	3080	485	1930	479	104	43.5	0.109	44.5	65.2	8.21	24.1
	Oct-07, 2004					498	124	54.4	0.102	49	92.4	9.56	22.6
	Oct-08, 2004	3.1	3650	722	2400	476	130	59.7	0.094	53.5	108	9.87	20.6
	Oct-09, 2004					454	119	51.4	0.086	41.7	93.7	9.31	19.1
	Oct-11, 2004					466	122	53	0.089	41.2	94.4	9.68	19.9
	Oct-12, 2004	3.2	3540	675	2280	483	135	60.3	0.09	45.4	112	10.4	20.4
	Oct-14, 2004					496	143	64	0.086	46.4	121	11.1	20
	Oct-16, 2004	3.1	3470	639	2300	497	135	58.8	0.087	43.8	112	10.5	19.7
	Oct-20, 2004	3.2	3190	551	1990	472	121	50.2	0.083	34.9	66.6	9.65	18.7
	Oct-24, 2004	3.3	2890	373	1600	467	103	35.9	0.083	23.4	37.2	8.27	18.8
	Oct-28, 2004	3.3	3070	469	2100	471	125	49.6	0.08	29	57.7	9.65	17.7
	Nov-01, 2004	3.3	3060	504	2010	426	119	51.2	0.076	30.3	25.9	8.71	16.4
	Nov-08, 2004	3.3	2630	428	1790	401	105	46.3	0.097	29.5	25.1	7.41	19.8
	Nov-15, 2004	3.3	2190	325	1420	348	74.2	34.1	0.106	30.8	7.23	5.08	22.7
	Nov-22, 2004	3.8	1390	202	1320	357	59.7	21.4	0.086	21.5	1.11	4.1	19
	Nov-29, 2004	3.8	1960	195	1470	358	60.9	22.6	0.091	22.3	1.42	4.13	19.9

5 Discussion

5.1 Impact of Spills from 3250 Level Portal

Impact of the Hydraulic Communication test on Mineral Creek was minimal, with no overtopping of the muck dam occurring at the 3250 portal. The semi-permeable dam functioned as planned by acting as a filter to attenuate the peak flow and sediment loading into Mineral Creek.

As the water exiting the 3250 tunnel was more turbid than normal (possibly due to flushing of sediment from the 3250 tunnel floor) some discharge of sediment occurred onto the forest floor, however most of this did not reach Mineral Creek.

The actual volumes that were spilled as a result of spill test 1 and spill test 2 were difficult to measure as they were passing through the dam and into the soil. Based on the observed maximum levels at the dam, spill volumes were estimated to be on the order of 72 cubic meters.

Although there were significant increases in concentrations of sulphate and metals in the discharge from the 3250 portal during the HCT test, concentrations in lower Mineral Creek and Britannia Creek remained within the range observed in the historical monitoring programs. This reflects the relatively small amount of discharge that was released during the test. Concentrations in Furry creek were also within historical ranges. The results of the recent sampling are consistent with more detailed monitoring completed in 2002, which suggested that groundwater is not a significant pathway for release of sulphate and metals from the mine workings to the receiving environment.

5.2 Effects of Flooding and Storage of Mine Water on Drainage Chemistry

Water quality data from the 2004 HCT test were compared to results of the 2002 plug test (SRK 2003) to determine whether there had been any changes resulting either from: changes in the amount of stored oxidation products present in the mine workings (for example depletion of soluble minerals resulting from flooding in the 2002 test); or, differences in the flow conditions during the test (for example the longer holding times and/or increased inflows during the latter half of the draindown period).

The comparisons are presented in Figures 5.1 and 5.2. In general, concentrations from the 2004 HCT test were similar to levels observed in the 2002 plug test, and tended to follow the same trends. This indicates that significant depletion of stored oxidation products had not occurred during the 2002 test. However, peak concentrations of several parameters were slightly lower than in the 2002 test. The reduction in peak concentrations may have been caused by increased inflows to the mine following a heavy rain storm in early October, which could have diluted water draining down through the mining core.

The only parameter that showed a significant increase above previously measured levels was iron, which reached peak concentrations of 120 mg/L compared to 80 mg/L in the 2002 test. It is likely that iron concentrations were higher in the 2004 test because of longer holding times within the mine, which would have allowed reducing conditions to develop. At peak concentrations, the iron is likely present in its reduced form (ferrous or Fe^{2+}).

Based on the general similarity of the results to the 2002 plug test results, the estimated water quality values during treatment plant operations as presented in SRK (2003) are still considered to be a reasonable basis for the design of the water treatment plant.

6 Conclusions

The 2004 Hydraulic Communication Test was intended primarily to prove that water could escape from the mine reservoir if the 4100 tunnel became blocked downstream of the raise. The HCT established that this hydraulic connection exists.

The test was not able to determine the capacity of the 3250 tunnel to carry water since it was not possible to spill the entire mine outflow without impacting Mineral Creek. However, it is likely that the 3250 tunnel could carry the full normal discharge of the mine (i.e. at least 300 l/s) as sufficient head would likely be available within the mine to overcome the effects of any small restrictions in the tunnel.

Based on the relatively short travel times seen in the test (averaging 2.4 hours) restrictions in the 3250 tunnel (probably due to small semi-permeable dams caused by slumps and fallen timbers) appear to be minimal. As the 3250 tunnel has never experienced major water flows, it is possible that a large outflow may remobilize floating wood and other debris and result in the blockage of the 3250 tunnel. In this case the 3100 tunnel portal would become the next exit level for mine drainage. At this time it is not possible to test the hydraulic connections to this level to verify that the 3100 tunnel is not blocked.

Although the HCT test resulted in a temporary increase to metal concentrations in the 3250 discharges, due to the small volumes of the discharges, impacts to the receiving environment were negligible.

Concentrations of sulphate and metals in drainage water were very similar to concentrations observed in the 2002 test, indicating that the estimated water quality during treatment plant operations is still a valid basis for the treatment plant design. However, minor variations in peak concentrations resulting from differences in inflows and retention time were evident in the data.

This report, **1CB012.010.106 – Report on Hydraulic Communications Test at 3250 Level**, was prepared by SRK Consulting (Canada) Inc and Klohn Crippen Consultants Ltd..

Prepared by

Graham Parkinson, P.Geo

Kelly Sexsmith, P.Geo

Reviewed by

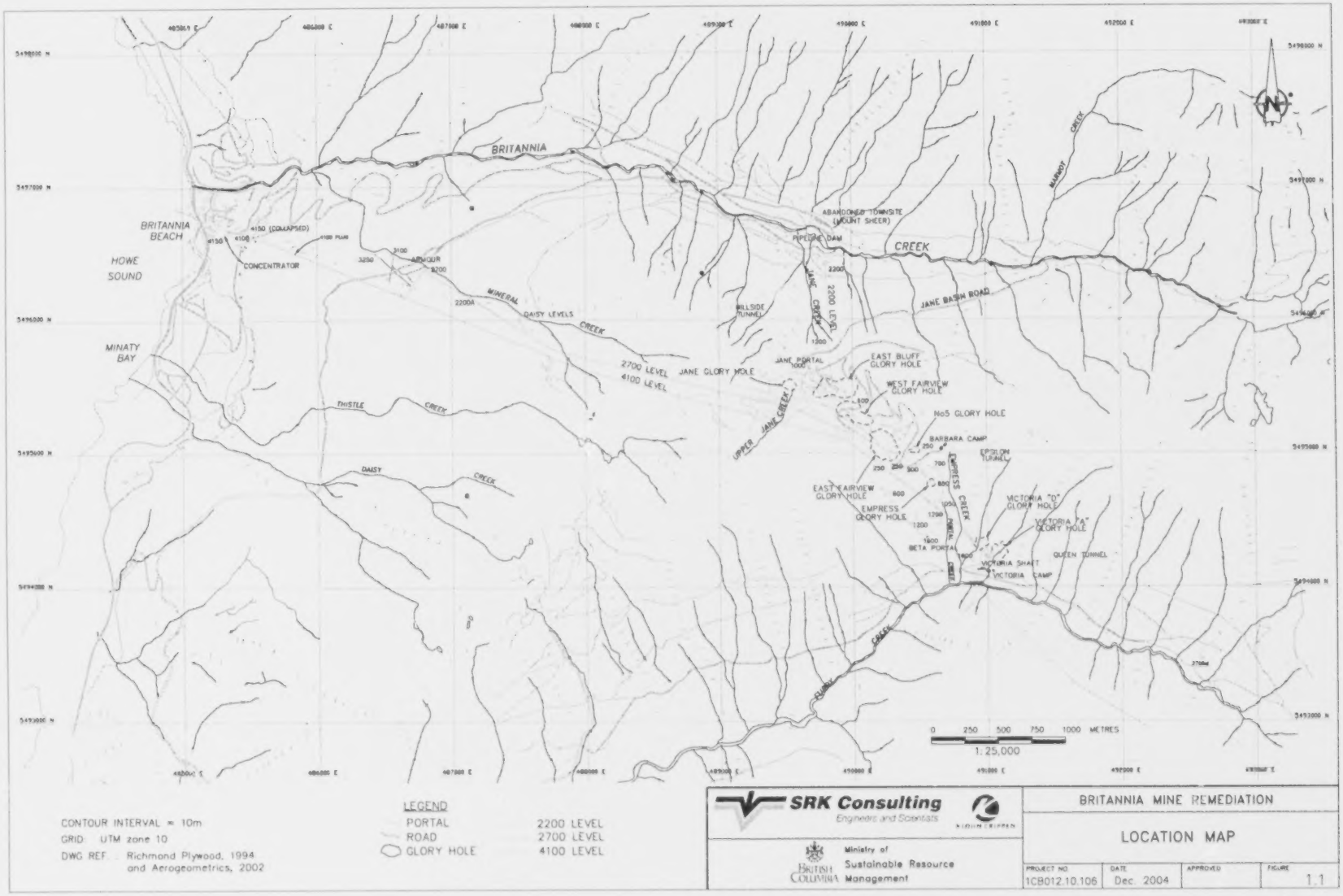
Peter Healey, P.Eng.

7 References

SRK/KC, 2003. 2002 Plug Test Plan.

SRK/KC, 2004. 2004 4100-3250 Tunnels Hydraulic Communications Test Plan.

Figures



CONTOUR INTERVAL = 10m
GRID: UTM zone 10
DWG REF.: Richmond Plywood, 1994 and Aerogeometrics, 2002

LEGEND

PORTAL
ROAD
GLORY HOLE

2200 LEVEL
2700 LEVEL
4100 LEVEL

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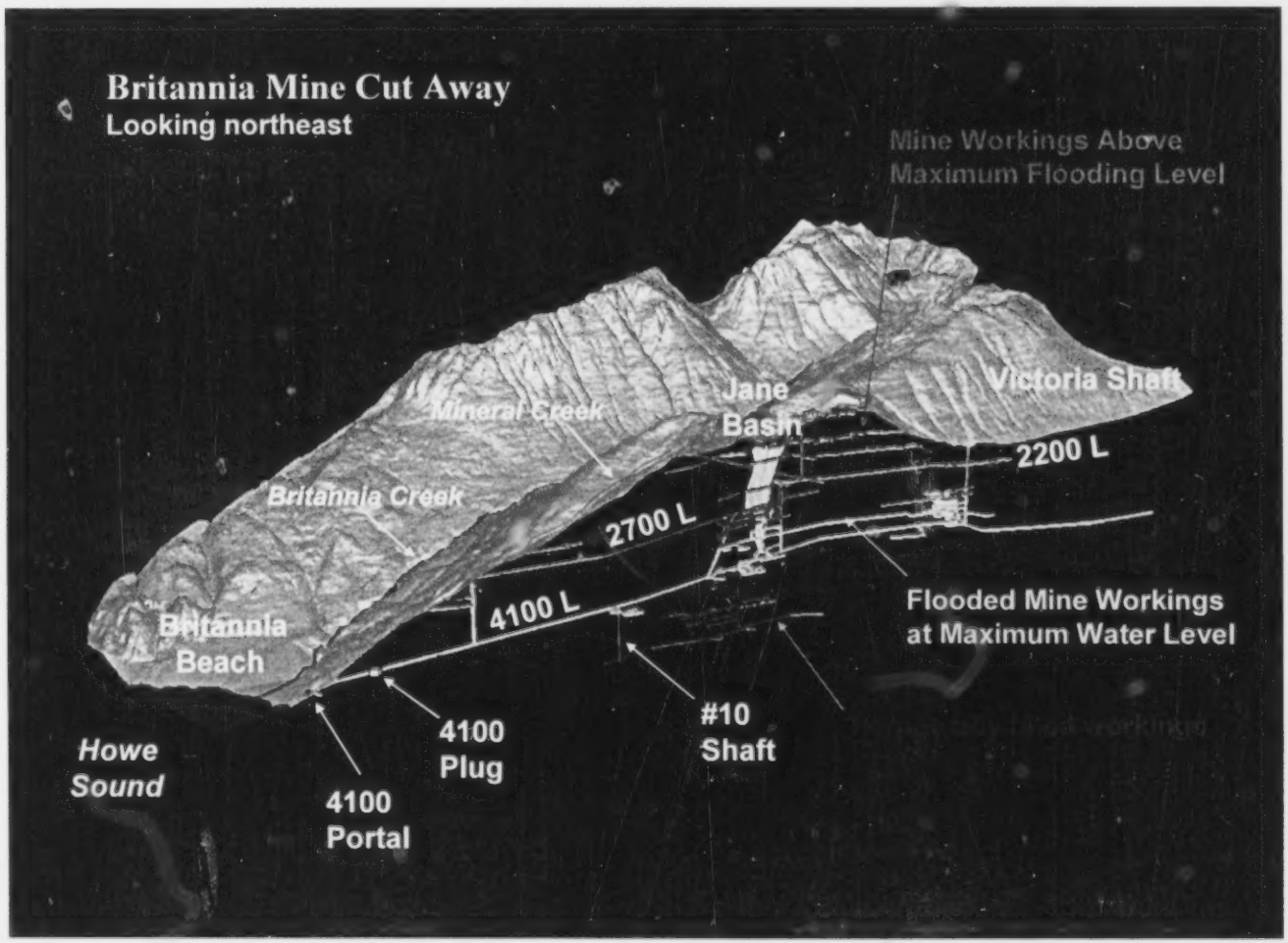
Engineers and Scientists

Ministry of Sustainable Resource Management
British Columbia

BRITANNIA MINE REMEDIATION

LOCATION MAP

PROJECT NO.	DATE	APPROVED	FIGURE
1CB012.10.106	Dec. 2004		1.1



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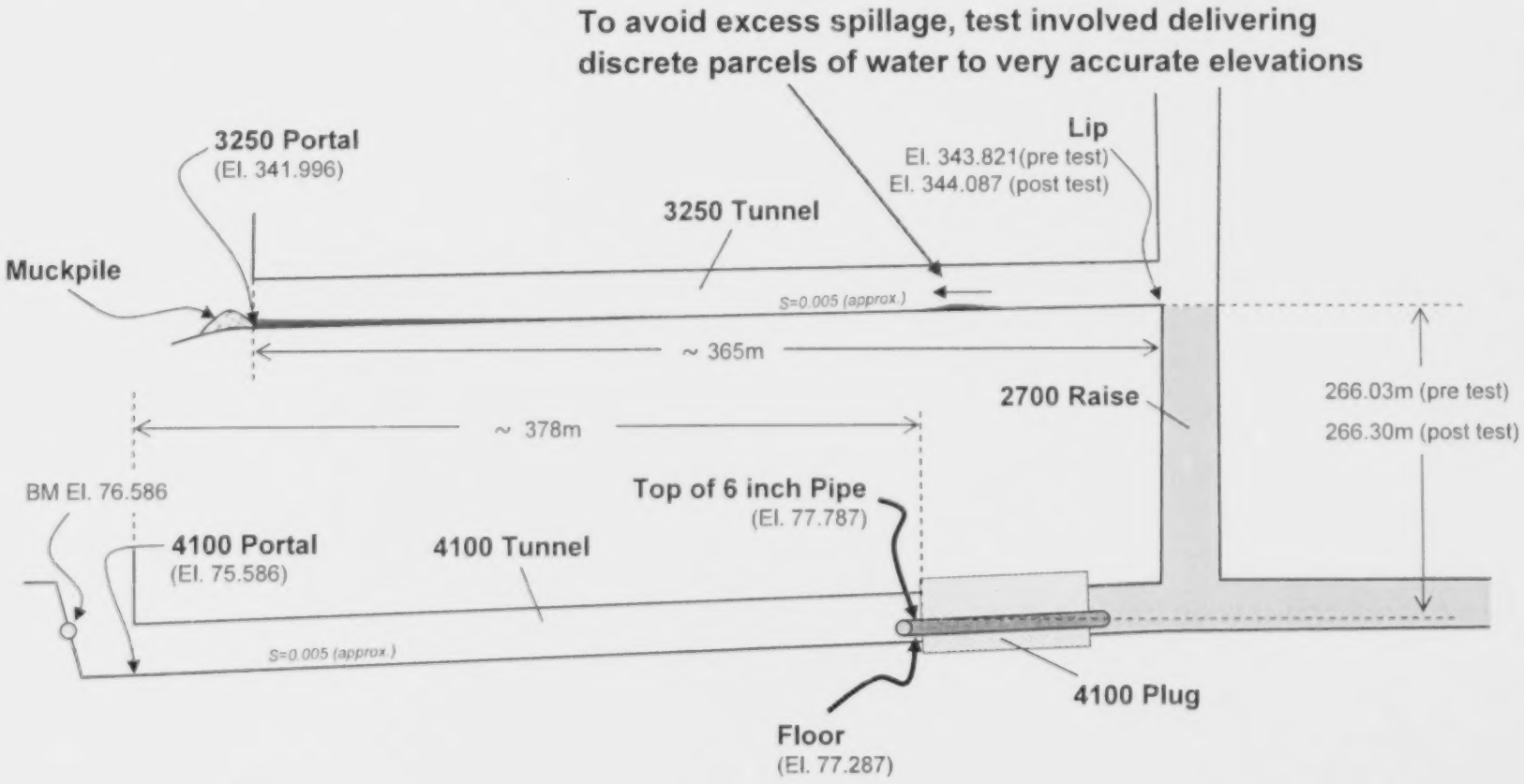
BRITISH COLUMBIA Ministry of Sustainable Resource Management

Britannia Mine Remediation
3250 Hydraulic Communication Test

Schematic View of Underground Workings

PROJECT:	DATE:	APPROVED:	FIGURE:
1CB012.10.106	Jan. 2005		2.1

Fig2.1 to 4.1_Hydraul_Test_1CB012.10.106_20050131.ppt



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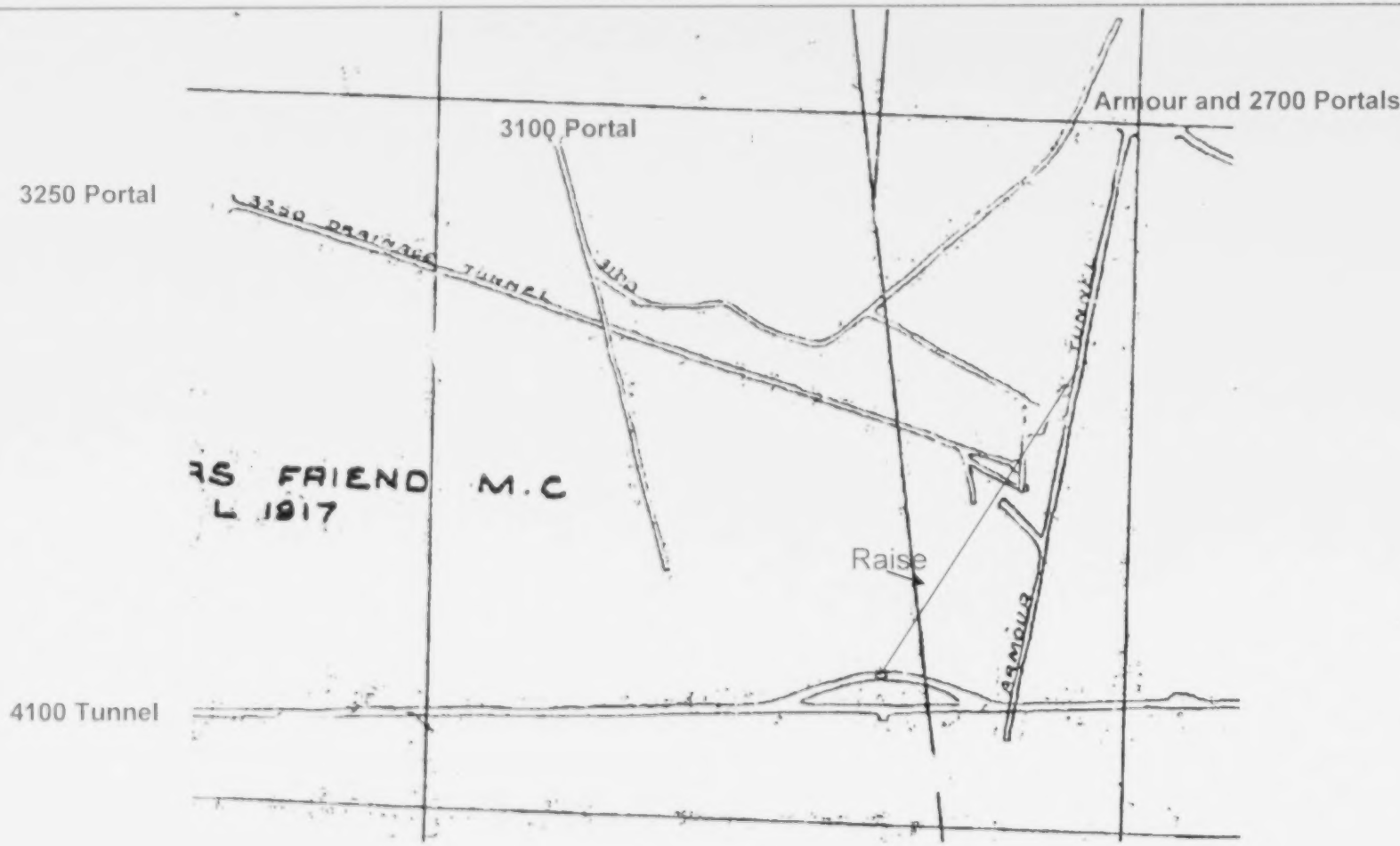
Britannia Mine Remediation
3250 Hydraulic Communication Test

Schematic Showing Elevations in 4100 and 3250 Tunnels

PROJECT	DATE	APPROVED	FIGURE
1CB012.10.105	Jan. 2005		2.2



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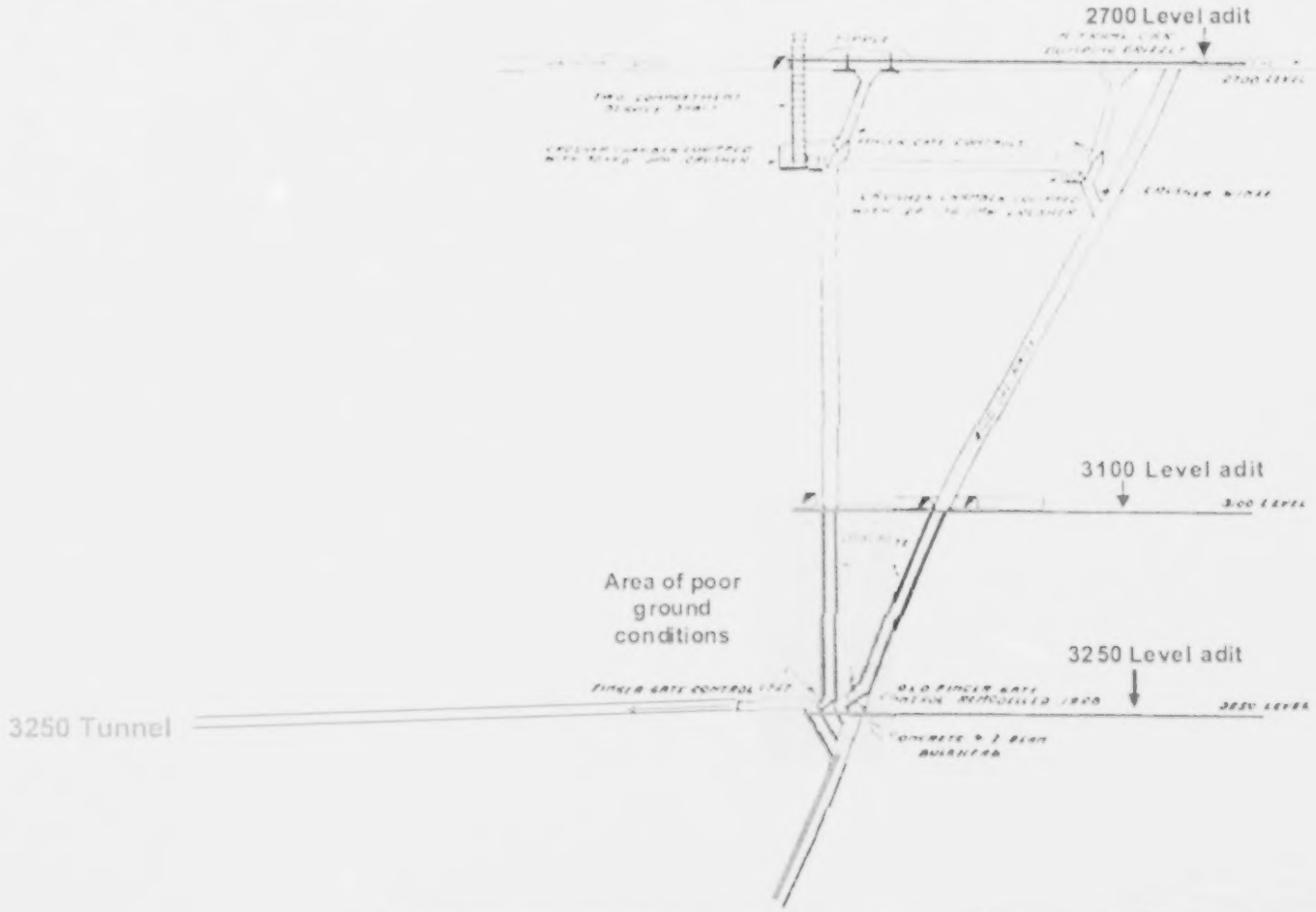
Britannia Mine Remediation
3250 Hydraulic Communication Test

Plan of 3250, 3100 and 4100 Tunnels

PROJECT	DATE	APPROVED	FIGURE
1CB012.10.106	Jan. 2005		2.3

Fig2.3 to 3.1_Hydraul_Test_1CB012.10.106_Jan05(1).ppt



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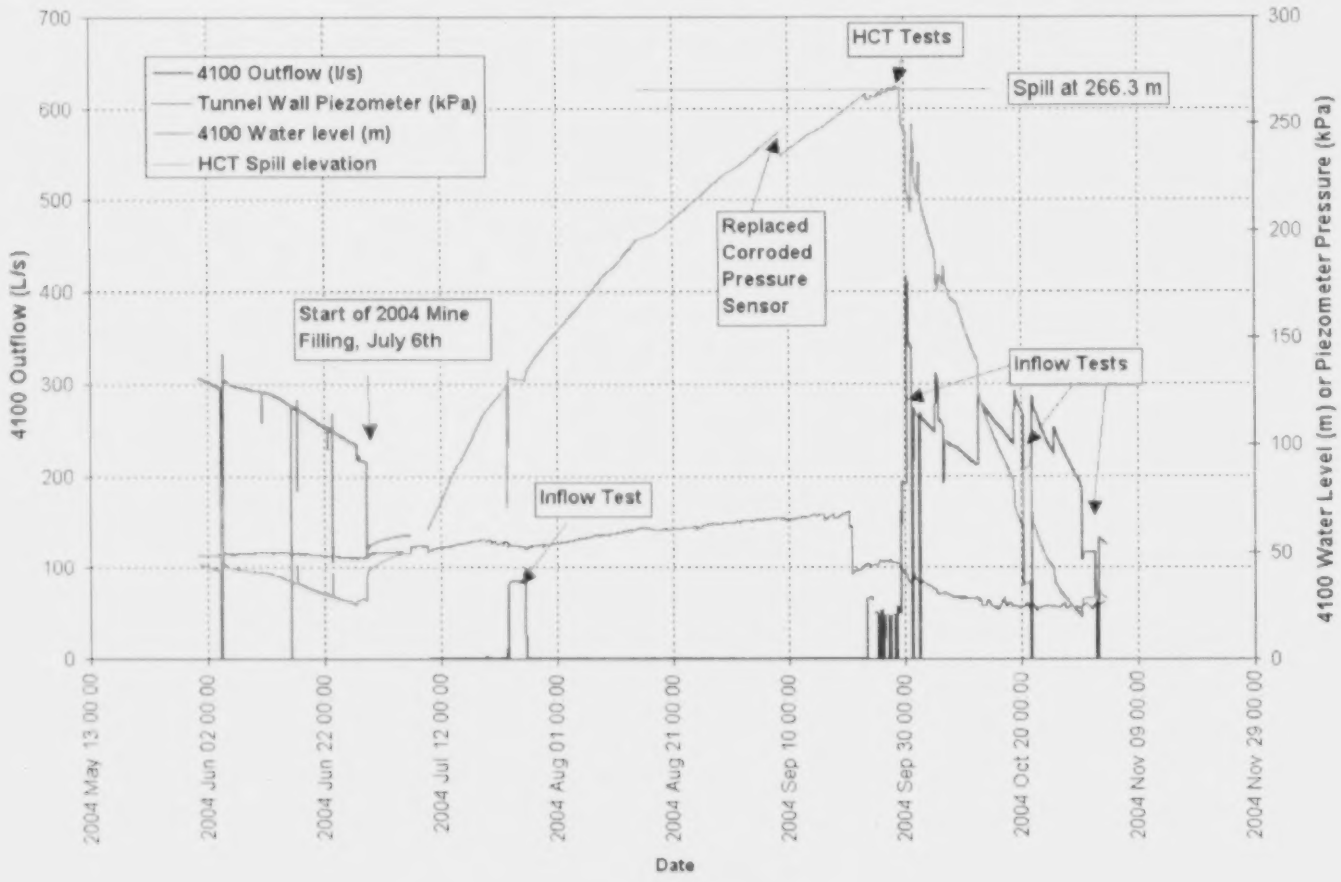
BRITISH COLUMBIA

Britannia Mine Remediation
3250 Hydraulic Communication Test

Detail View of Intersections of Raise and 3100/2700 Tunnels

PROJECT:	DATE:	APPROVED:	FIGURE:
1CB012.10.106	Jan. 2005		2.4


4100 Outflow (l/s)
Tunnel Wall Piezometer (kPa)
4100 Water level (m)
HCT Spill elevation
HCT Tests
Spill at 266.3 m
Replaced Corroded Pressure Sensor
Start of 2004 Mine Filling, July 6th
Inflow Tests
Inflow Test
4100 Outflow (L/s)
4100 Water Level (m) or Piezometer Pressure (kPa)
Date
2004 May 13 00 00
2004 Jun 02 00 00
2004 Jun 22 00 00
2004 Jul 12 00 00
2004 Aug 01 00 00
2004 Aug 21 00 00
2004 Sep 10 00 00
2004 Sep 30 00 00
2004 Oct 20 00 00
2004 Nov 09 00 00
2004 Nov 29 00 00

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BRITISH COLUMBIA

Britannia Mine Remediation
3250 Hydraulic Communication Test

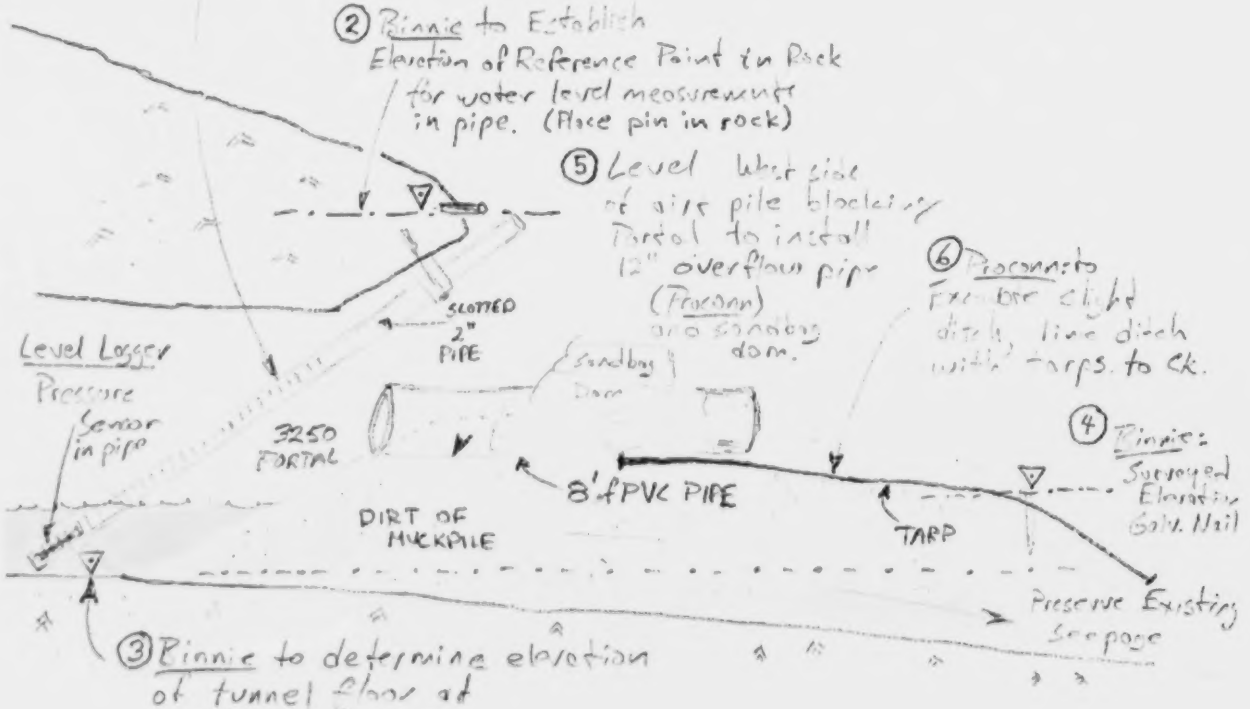
Schematic showing Elevations in 4100 and 3250 Tunnels

PROJECT	DATE	APPROVED	FIGURE
1CB012.10.106	Jan. 2005		3.1

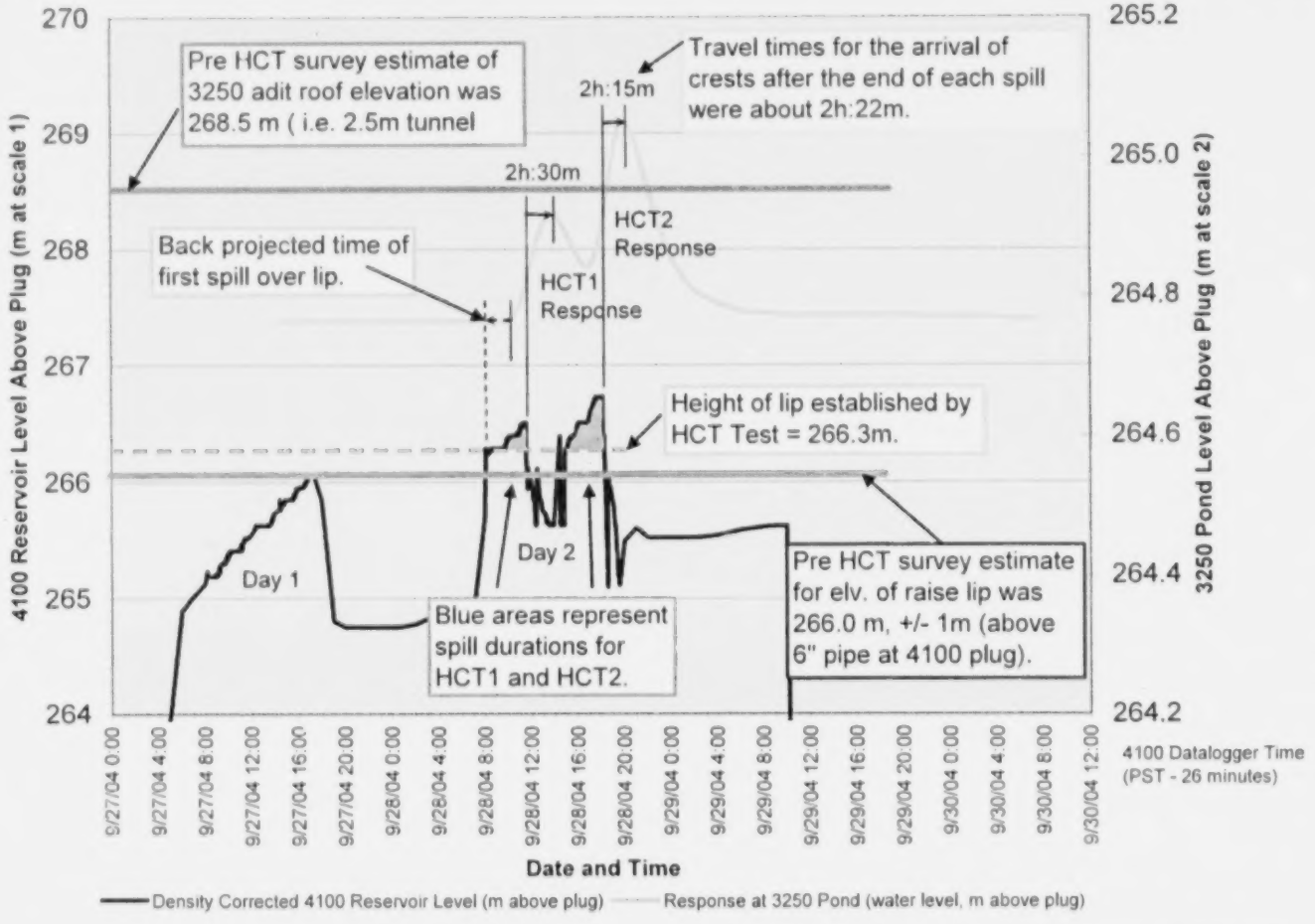
Fig3.1 to 4.1_Hydraul_Test_1CB012.10.106_20050111.ppt

INSTALLATIONS:

① Procona to install 2" ID plastic pipe, bolted to rock as holder for pressure sensor. Pipe blanked + slotted at bottom.


② Rinnie to Establish Elevation of Reference Point on Rock for water level measurements in pipe. (Place pin in rock)
⑤ Level what side of pile blocking Portal to install 12" overflow pipe (Procona) and sandbag dam.
⑥ Procona to excavate right ditch line ditch with tarps to ck.
SLOTTED 2" PIPE
Level Logger Pressure Sensor in pipe
3250 PORTAL
Sandbag Dam
④ Rinnie: Surveyed Elevation Galv. Nail
8' fPVC PIPE
DIRT OF MUCKPILE
TARP
Preserve Existing Seepage
③ Rinnie to determine elevation of tunnel floor at position of sensor. (This allows projection back to determine height of overflow point in mine)

SRK Consulting Engineers and Scientists / KLOHN CRIPPEN	Britannia Mine Remediation 3250 Hydraulic Communication Test		
Ministry of Sustainable Resource Management, British Columbia	**3250 Portal Area Preparations**		
PROJECT: 1CB012.10.106	DATE: Jan. 2005	APPROVED:	FIGURE: **3.2**



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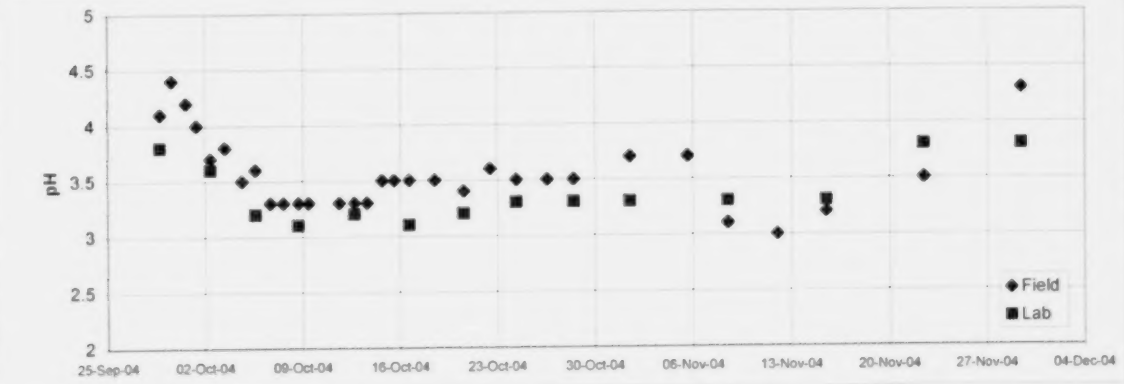
BRITISH COLUMBIA

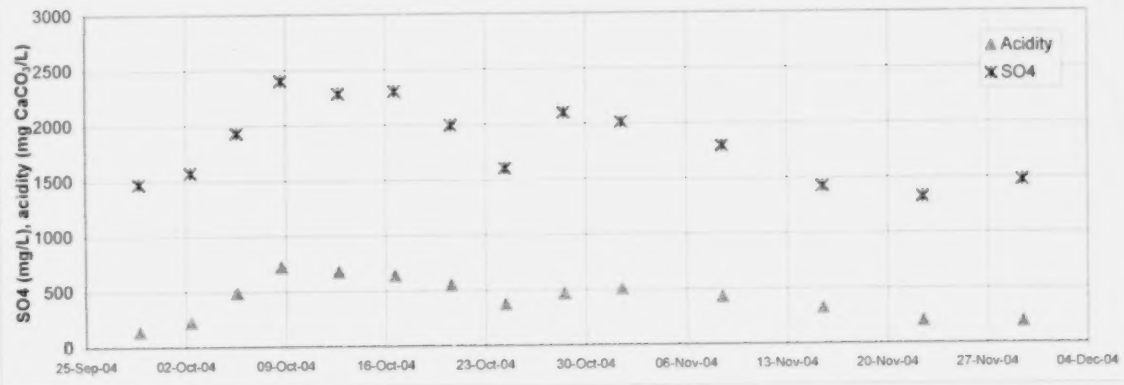
Britannia Mine Remediation
3250 Hydraulic Communication Test

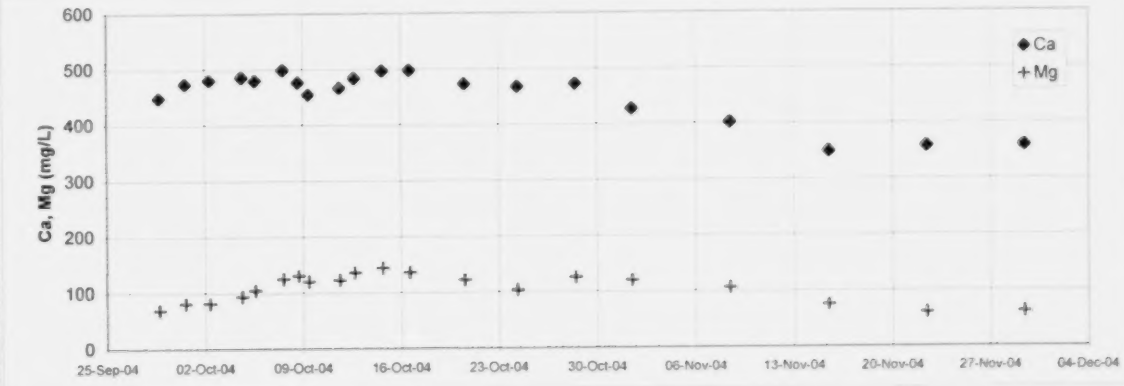
2004 HCT Test Results

PROJECT:	DATE:	APPROVED:	FIGURE:
1CB012.10.106	Jan. 2005		4.1

Fig2 1 to 4 1_Hydraul_Test_1CB012.10.106_20050131.ppt







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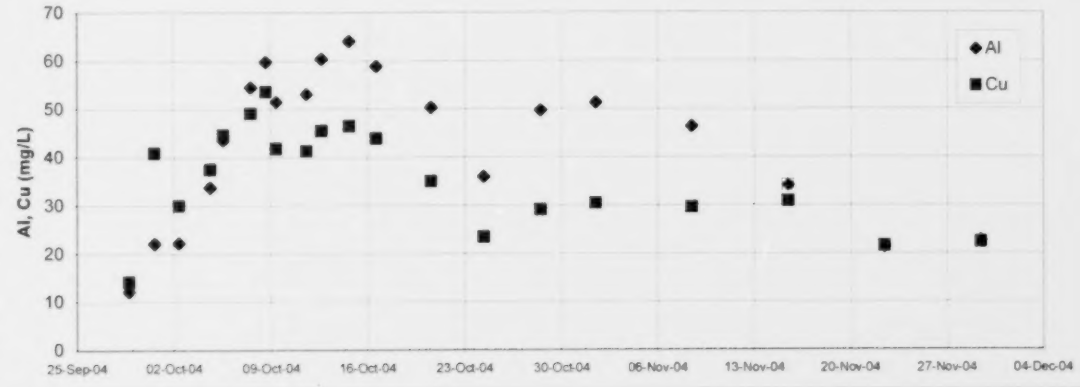
BRITISH COLUMBIA Sustainable Resource Management

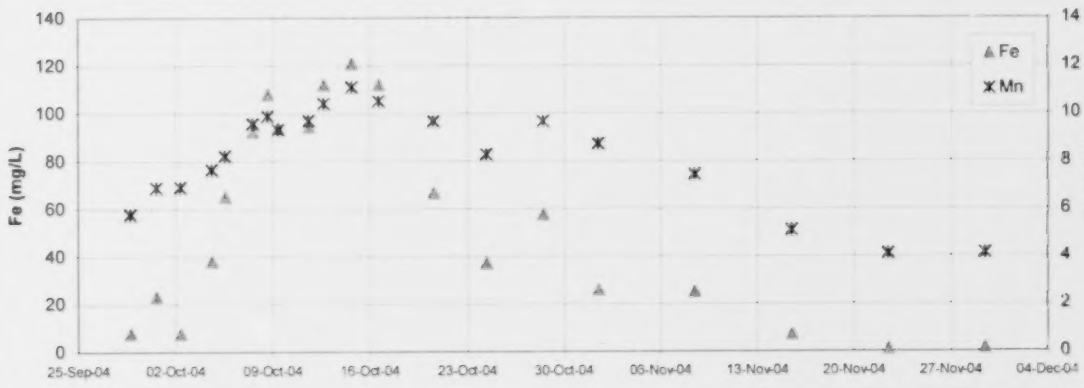
BRITANNIA MINE REMEDIATION

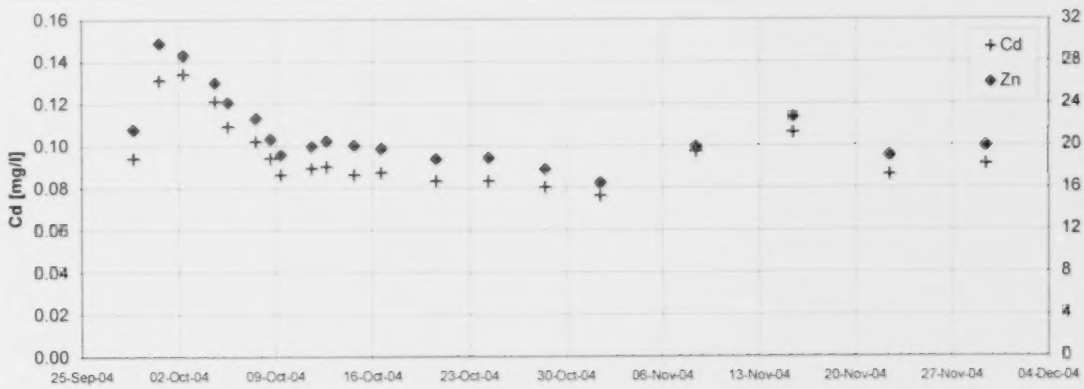
4100 Drainage Chemistry
General Parameters

PROJECT	DATE	APPROVED	FIGURE
1CB012.10.106	Jan, 2005		4.2

Britannia_HCT_Figures_KW_20050201.xls/Fig. 4.2







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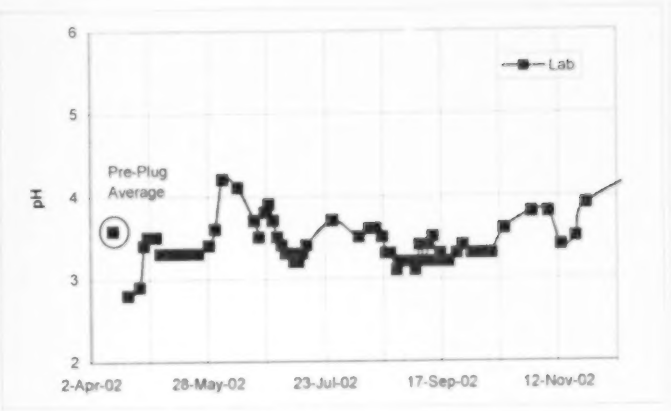
British Columbia

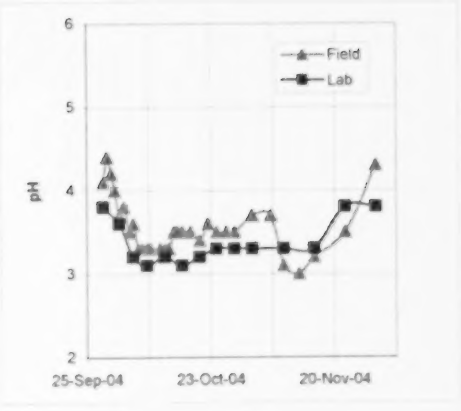
BRITANNIA MINE REMEDIATION

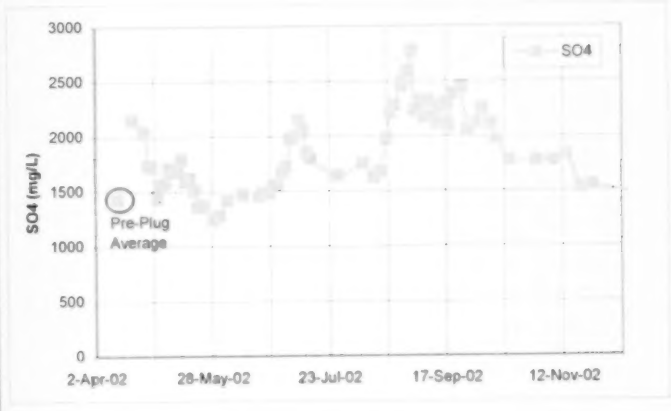
4100 Drainage Chemistry
Metal Analyses

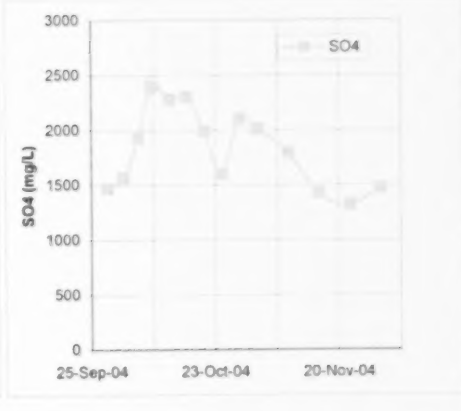
PROJECT	DATE	APPROVED	FIGURE
1CB012.10.106	Jan. 2005		4.3

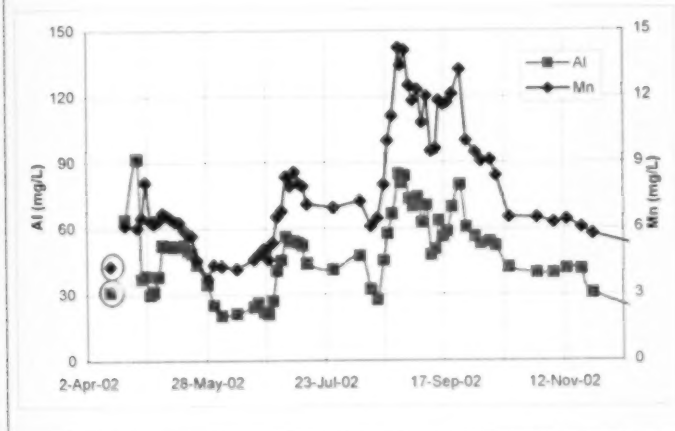
Britannia_HCT_Figures_KW_20050201.xls/Fig 4.3

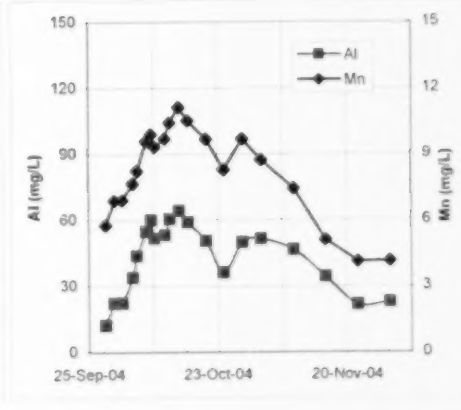












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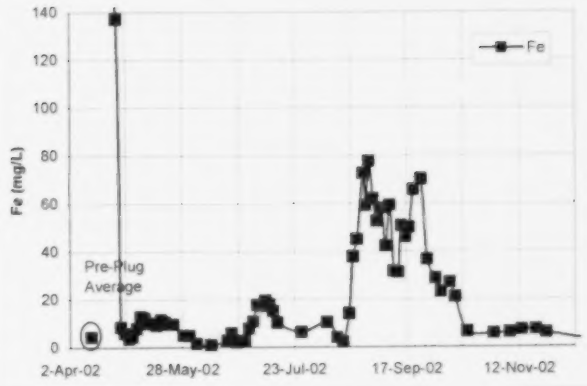
BRITANNIA MINE REMEDIATION

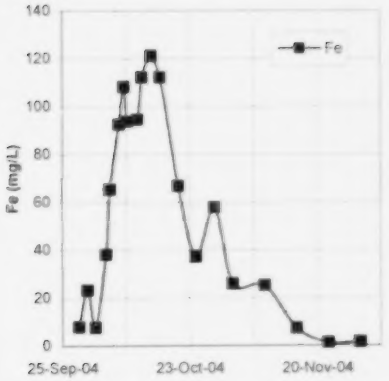
4100 Drainage Chemistry Comparison
2002 and 2004 Data (pH, SO4, Al, Mn)

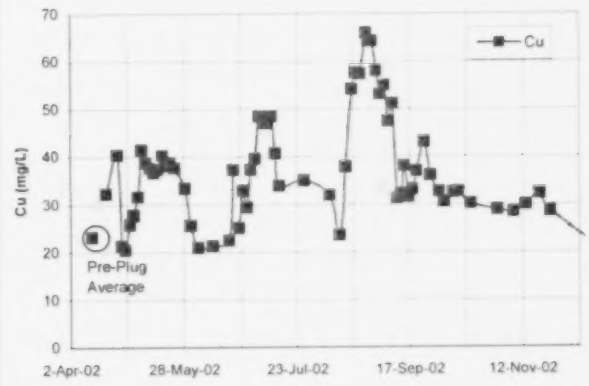
Ministry of Sustainable Resource Management
BRITISH COLUMBIA

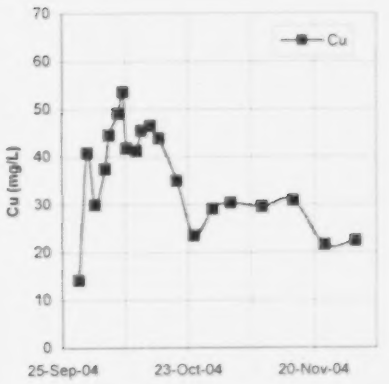
PROJECT	DATE	APPROVED	FIGURE
1CB012.10.106	Jan. 2005		5.1

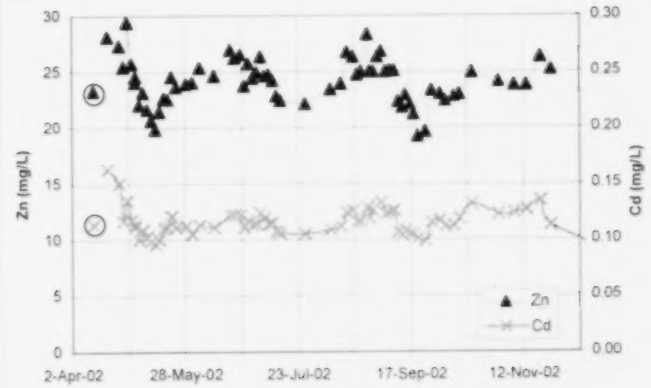
Britannia_HCT_Figures_KW_20050201.xls/Fig. 5.1

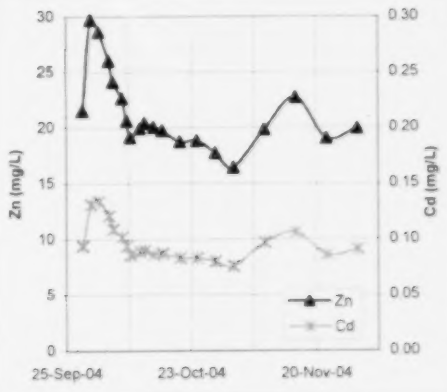












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British Columbia

BRITANNIA MINE REMEDIATION

4100 Drainage Chemistry Comparison
2002 and 2004 Data (Fe, Cu, Zn, Cd)

PROJECT	DATE	APPROVED	FIGURE
1CB012.10.106	Jan. 2005		5.2

Britannia_HCT_Figures_KW_20050201.xls/Fig 5.2

Appendix I

Permit AE-17688

BRITISH COLUMBIA

BY MAIL AND FAX

AUG - 5 2004

Site: 436
Permit No: PR-17488

Government of British Columbia
c/o Brian Clarke
Director, Contaminated Site Management
Ministry of Sustainable Resources Management
PO Box 9361 Stn Prov Govt
Victoria BC V8W 9M2

Dear Brian:

Re: Approval for Effluent Discharge to Howe Sound from 2004 Plug Test at Britannia Mine

Please find attached Approval AE-17688 authorizing the discharge of minewater to the deep outfall in Howe Sound from the 4100 Level portal of the Britannia Mine. The authorization is provided to allow testing of the 4100 Level plug as described in the Ministry of Sustainable Resource Management's (SRM) July 26, 2004 application entitled *Britannia Mine Remediation Project – Approval Request for Discharge in Conducting the 2004 Plug Test*, prepared by Golder Associates Ltd., and in the supporting technical report entitled the *4100-3250 Tunnel Hydraulic Communication Test Plan*, prepared by SRK-Klohn Crippen, August, 2004. These documents can be viewed at SRM's Britannia Mine Remediation website at http://srmwww.gov.bc.ca/clrg/britannia

The 2004 plug test is being conducted in a manner and under conditions similar to that of the 4100 Level Plug Test successfully conducted in 2002 and authorized in the now-expired Approval AE-17111. The test is considered necessary to allow SRM to develop final specifications for construction of the permanent Water Treatment Plant that will treat acid rock drainages from the Britannia Mine in late 2005.

This decision may be appealed to the Environmental Appeal Board. Notice of the appeal must (1) be in writing, (2) include the grounds for appeal, (3) be directed by registered mail or personally delivered to the Chair, Environmental Appeal Board, 4th Floor 836 Yates Street, Victoria British Columbia V8V 1X4, (4) be delivered within 30 days from

the date notice of the decision is given, and (5) be accompanied by a fee of $25, payable to the Minister of Finance and Corporate Relations. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

Plans and reports prepared under the approval should be submitted to me and copied to Peggy Evans, Senior Contaminated Sites Officer. Copies should be made available to stakeholder representatives on the Britannia Mine Remediation Distribution List through posting to the Ministry of Sustainable Resources Management's dedicated web site and e-mail notification or by mail or fax.

Any questions in connection with the approval should be directed to Peggy Evans at (250) 356-8386 or Peggy.Evans@gems3.gov.bc.ca.

Yours truly,

Eric Partridge
Director of Waste Management

cc: Distribution List

BRITISH COLUMBIA

MINISTRY OF WATER, LAND AND AIR PROTECTION

APPROVAL
AE - 17688

Under the Provisions of the Environmental Management Act

The Province of British Columbia
as represented by the Minister of Sustainable Resource Management
Parliament Buildings
Victoria, British Columbia
V8V 1X4

is authorized to discharge effluent to Howe Sound from remediation activities at the former Britannia Mine Site located at Britannia Beach, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is violation of the *Environmental Management Act* and may result in prosecution.

1.0 AUTHORIZED DISCHARGES

1.1 This section applies to the discharge of effluent consisting of acid rock drainage that has been stored within the internal mine workings during testing of the 4100 Level plug to evaluate the potential for minewater overflow out the 3250 Level portal.

1.1.1 Discharges from the 4100 Level mine portal to the deep outfall in Howe Sound authorized under this approval:

- Shall not exceed a maximum discharge rate of 500 litres per second during any period of mine draindown;
- Shall not exceed during any day of mine draindown, the following scheduled discharge rates for specified concentrations of dissolved copper.

Concentration of Total Copper (mg/L)	Average Daily Discharge Rate (L/s)
Less than 35	450
35 to 45	350
46 to 55	250
Greater than 55	150

04.08.05
Date issued:

Eric Partridge
Director of Waste Management

Dissolved copper concentrations shall be determined on the basis of the most recent sampling of the effluent in accordance with requirements set out in Section 3.1 of the Approval

1.1.2 The authorized period of discharge is from September 1, 2004, to November 15, 2004.

1.1.3 The characteristics of the effluent shall be acid rock drainage.

1.1.4 The legal description for the facilities from where the discharge originates is: Lots 891 and 892, Plan 19960 North Shore, Squamish Valley Assessment Area.

1.1.5 The legal description of the point of discharge is to Howe Sound, adjacent to the legal address provided above, as shown on Site Plan A.

2.0 GENERAL REQUIREMENTS

2.1 Draindown Plan

Draindown of stored minewater shall occur as described in Section 1.0 of this Approval and as per the conditions of the Approval AE-17111 (March 13, 2002) and Amendments (April 22, 2002 and August 8, 2002) authorizing the 4100 Level Plug Test conducted in 2002. Procedures are described in *Britannia Mine Remediation Project – Approval Request for Discharge in Conducting the 2004 Plug Test*, prepared by Golder Associates Ltd., July 26, 2004 and the *4100-3250 Tunnel Hydraulic Communication Test Plan*, prepared by SRK-Klohn Crippen, August, 2004.

2.2 Maintenance of Works

The Approval Holder shall inspect the authorized works prior to discharge of stored minewater and maintain them in good working condition throughout the duration of the discharge. The Director shall be notified of any malfunction of the works.

2.3 Bypasses

Effluent discharge other than through the authorized works is prohibited, subject to Section 2.5 of this approval and the express written approval of the Director.

2.4 Process Modifications

The Director shall be notified prior to any change in process that may adversely affect the quality and/or quantity of the discharge being implemented.

AUG - 5 2004

Date issued:

Eric Partridge
Director of Waste Management

2.5 Emergency Procedures

In the event of an emergency which prevents compliance with a requirement of this approval, that requirement will be suspended for such time as the emergency continues or until otherwise directed by the Director provided:

a. Due diligence was exercised in relation to the process, operation or event which caused the emergency and that the emergency occurred notwithstanding this exercise of due diligence;

b. The Director is immediately notified of the emergency; and

c. It can be demonstrated that everything possible is being done to restore compliance in the shortest possible time.

Notwithstanding (a), (b), and (c) above, the Director may require the operation to be suspended or restricted to protect the environment while the situation is corrected.

2.6 Units of Measure

The International System of Units (SI) shall be used when submitting plans, specifications, monitoring results or any other information associated with this Approval.

3.0 MONITORING AND REPORTING REQUIREMENTS

3.1 Monitoring and Sampling of Minewater Discharge during Draindown

The Approval Holder shall monitor and sample minewater discharges according to procedures described in *Britannia Mine Remediation Project – Approval Request for Discharge in Conducting the 2004 Plug Test* (the Approval Request), prepared by Golder Associates Ltd., July 26, 2004 and the *4100-3250 Tunnel Hydraulic Communication Test Plan*, prepared by SRK-Klohn Crippen, August, 2004, and subject to the following conditions:

- At effluent concentrations below 45 mg/L, effluent samples shall be collected every second day and submitted for laboratory analysis of dissolved copper;
- Effluent sampling shall be augmented by daily colourimetric testing as described in the documents referenced in Section 2.1 of this Approval;
- At effluent concentrations above 45 mg/L effluent samples shall be collected daily and submitted for laboratory analysis of dissolved copper;

AUG 3 2004

Date issued:

Eric Partridge
Director of Waste Management

AE – 17688

- Effluent samples shall be collected every 4 days for the analysis of parameters specified under Section 3.5 of this Approval;
- The Director shall be notified where effluent concentrations are measured above 60 mg/L. Notification shall occur on the date results are received and shall be submitted by fax or e-mail;
- Dissolved copper concentrations shall be determined on the basis of the most recent sampling of the effluent;
- Effluent sampling results shall be tabulated in bi-weekly progress reports submitted to the Director in accordance with current reporting procedures;

3.2 Sampling of Local Surface Waters and Mine Portals

The Approval Holder shall sample the local surface waters of Mineral Creek, Britannia Creek and Furry Creek and the 3250 and 3100 Level mine portals as described in the July 26, 2004 Approval Request. Additional procedures described in the Approval Request and/or the *4100-3250 Tunnel Hydraulic Communication Test Plan*, prepared by SRK-Klohn Crippen, August, 2004. for monitoring water elevations and potential hazards at the 3250 Level portal shall be implemented.

3.3 Sampling and Flow Monitoring Methods

Sampling shall be carried out in accordance with procedures described in the latest version of "British Columbia Field Sampling Manual for Continuous Monitoring plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 1996 Edition (Permittee)," or by suitable alternative procedures as authorised by the Director.

3.4 Analytical Parameters and Methods

Samples of effluent, surface water, seepage, and portal discharges, shall be analysed for pH, sulphate, and total metals including aluminium, cadmium, copper, iron, manganese, and zinc, and any other parameters considered necessary by the Approval Holder to adequately interpret the results of the plug test.

Analyses shall be carried out in accordance with procedures described in the latest version of "British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials (March 1994 Permittee Edition)", or by suitable alternative procedures as authorized by the Director.

AUG - 5 2004

Date issued:

Eric Partridge
Director of Waste Management

AE – 17688

3.5 Reporting

The Approval Holder shall provide the Director within 31 days of the completion of the 2004 Plug Test, a report that includes, but is not necessarily limited to:

- a summary of the results of chemistry sampling and monitoring conducted under Section 3.0;
- conclusions drawn on the basis of the results; and
- recommendations for remedial planning and water treatment plant design for the Britannia Mine Site.

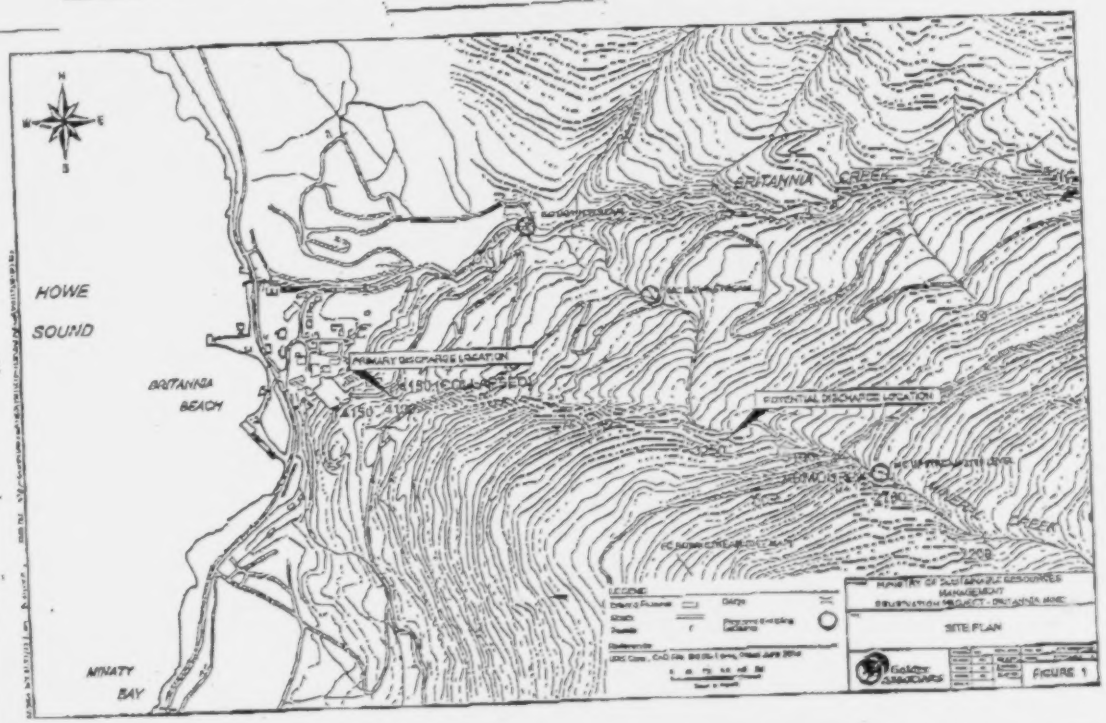
AUG - 5 2004

Date issued:

AE - 17688

Eric Partridge
Director of Waste Management

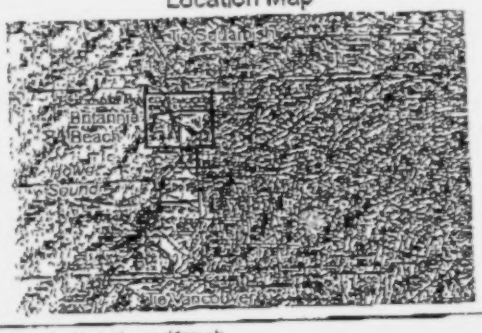
SITE PLAN



Legal Description:

Lots 891 and 892, Plan 19960 North Shore, Squamish Valley Assessment Area

Location Map



Appendix: **Site Plan A**

Approval: AE17688

Date AUG - 5 2004 Director of Waste Management

LOG # .00520
FILE #: 26250-20/BMR REM
325C

BRITISH COLUMBIA

RECEIVED
OCT 19 2004
MSRM - CLRG DIV - 4th FLOOR

BM-160
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OCT 19 2004

BY MAIL AND FAX

Site: 436
Permit No: PR-17488

Government of British Columbia
c/o Brian Clarke
Director, Contaminated Site Management
Ministry of Sustainable Resources Management
PO Box 9361 Stn Prov Govt
Victoria BC V8W 9M2

Dear Brian:

Re: Amendment to Monitoring Requirements (Item 3.0) of Approval AE-17688 authorizing Effluent Discharge to Howe Sound from 2004 Plug Test at Britannia Mine

The following amendment to the monitoring requirements of Approval AE-17688 is provided on the basis of the October 13, 2004 email request submitted by Golder Associates on behalf of the Ministry of Sustainable Resources Management (attached).

For clarity, amended items are recited in full below and changes underlined.

3.1 Monitoring and Sampling of Minewater Discharge during Draindown

The Approval Holder shall monitor and sample minewater discharges according to procedures described in *Britannia Mine Remediation Project – Approval Request for Discharge in Conducting the 2004 Plug Test* (the Approval Request), prepared by Golder Associates Ltd., July 26, 2004 and the *4100-3250 Tunnel Hydraulic Communication Test Plan*, prepared by SRK-Klohn Crippen, August, 2004, and subject to the following conditions:

- At effluent concentrations below 45 mg/L, effluent samples shall be collected every fourth day and submitted for laboratory analysis of dissolved copper;

Ministry of Water, Land and Air Protection | Office of the Assistant Deputy Minister | Mailing Address: PO Box 9339 Stn Prov Govt Victoria BC V8W 9M1 | Location: 5th Floor, 2975 Jutland Road Victoria BC

- Effluent sampling shall be augmented by colourimetric testing every second day as described in the documents referenced in Section 2.1 of this Approval and October 13, 2004 amendment request;
- At effluent concentrations above 45 mg/L effluent samples shall be collected daily and submitted for laboratory analysis of dissolved copper;
- Effluent samples shall be collected every 4 days for the analysis of parameters specified under Section 3.5 of this Approval;
- The Director shall be notified where effluent concentrations are measured above 60 mg/L. Notification shall occur on the date results are received and shall be submitted by fax or e-mail;
- Dissolved copper concentrations shall be determined on the basis of the most recent sampling of the effluent;
- Effluent sampling results shall be tabulated in bi-weekly progress reports submitted to the Director in accordance with current reporting procedures;

3.2 **- Unchanged from original -**

3.3 **- Unchanged from original -**

3.4 **Analytical Parameters and Methods**

Samples of effluent, surface water, seepage, and portal discharges, shall be analysed for pH, sulphate, and dissolved metals including aluminium, cadmium, copper, iron, manganese, and zinc, and any other parameters considered necessary by the Approval Holder to adequately interpret the results of the plug test.

Analyses shall be carried out in accordance with procedures described in the latest version of "British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials (March 1994 Permittee Edition)", or by suitable alternative procedures as authorized by the Director.

Any questions in connection with the approval should be directed to Peggy Evans at (250) 356-8386 or Peggy.Evans@gems3.gov.bc.ca.

Yours truly,

Eric Partridge
Director of Waste Management
Attachment

cc: Distribution List

-----Original Message-----
From: O'Hara, Gerry [mailto:Gerry_OHara@golder.com]
Sent: October 13, 2004 12:16 PM
To: Evans, Peggy L WLAP:EX
Cc: McCrea, Jim; Hammett, Ross; Azevedo, Barry WLAP:EX
Subject: Britannia: 3250 - 4100 Level Hydraulic Communications Test

Peggy,
Further to our earlier discussions on the sampling and analysis requirements for the draindown phase of the 3250 - 4100 Level hydraulic communications test (commenced September 29, 2004), we have been reviewing the data gathered to date with SRK staff. Also, the sampling and analysis program has been reviewed as part of background information gathering effort for WTP operational consideration in an effort to extract the maximum amount of data pertinent to this need. As a result, we request MWLAP's consideration of the following changes to Permit AE-17688 (Permit):

Proposed Reductions:
1) The monitoring requirements in the Permit include daily field copper readings, laboratory copper analyses (dissolved) every second day where Cu concentrations are less than 45 mg/L, and daily where Cu concentrations are greater than 45 mg/L, and a full suite of analysis every fourth day. Based on the experience gained during the 2002 plug test, we propose to reduce the frequency of the field copper readings to every second day, and laboratory readings to every fourth day where copper concentrations are less than 45 mg/L, except where we are approaching a critical threshold for controlling flow from the mine (see below).

The technical basis for this request is the experience gained during the 2002 plug test. The results from the 2002 plug test indicated:

a) good correlations between field and laboratory copper readings, indicating that the field copper readings were a valid basis for controlling flow from the mine.

b) the rate of change in copper concentrations was adequately captured by sampling every second day.
c) the peak in concentrations during the final draindown phase was relatively sharp, and it was appropriate to increase the sampling frequency during this brief period to ensure that there were multiple samples representing this chemistry.

Field copper readings will be collected each day when concentrations approach the thresholds for further control of flow, or when they exceed 45 mg/L. A full suite of analyses (including dissolved copper) will also be collected every second day when copper levels exceed 45 mg/L. This suite will include all of the analyses completed in the 2002 plug test which are likely to be useful for the WTP operators.

2) The Permit includes a requirement for total metals in the full suite of analysis. In general, total and dissolved metals concentrations observed in the mine drainage are very close. However, dissolved metals samples are not as subject to sampling problems, such as accidental entrainment of particles during sampling, and they provide more meaningful results for the geochemical interpretation and treatment plant operators. In the 2002 plug test, total metals were not included in the analytical suite. SRK geochemists believe the total metals data has limited value and, therefore, propose dropping this analytical requirement from full suite samples.

Proposed increases.
1) Field readings (pH, conductivity, redox and temperature) be included along with the copper reading. These readings are another good instant indication of how things are changing and help to validate the field copper readings.

2) The current suite of parameters does not include conductivity, TDS, acidity or dissolved metals - all of which have been monitored in the regular monthly samples and the original plug test draindown. Acidity is an essential parameter for the treatment plant. Dissolved metals are more meaningful than total metals.

3) The frequency of a full set of analyses should be increased over the permit requirement once we start approaching peak concentrations. The peak in the 2002 data was short-lived and could be missed with the 4 day frequency specified in the permit.

I will call you to discuss.
Regards
Gerry

Gerry O'Hara M.Phil. P.Eng., Principal
Golder Associates Ltd.
500-4260 Still Creek Drive
Burnaby, British Columbia
V5C 6C6, CANADA
Tel:(604) 296-4216, Fax: (604) 298-5253
Cell: (604) 802-6517

Appendix II

3250 and Receiving Water Monitoring Data

Appendix II: 3250 and Receiving Water Monitoring Data

Parameter	Units	Method Detection Limit	Brit d/s				Min u/s			Min d/s				
			17-Aug-04 16:00	29-Sep-04 08:30	29-Sep-04 (duplicate) 08:30	05-Oct-04 16:00	13-Aug-04 12:30	28-Sep-04 15:25	05-Oct-04 10:15	13-Aug-04 16:00	28-Sep-04 17:30	29-Sep-04 11:45	05-Oct-04 13:15	05-Oct-04 (duplicate) 13:15
FIELD READINGS														
Flow				na	na	na		na	na		na	na	na	na
pH			6.5	6.9	6.9	6.6		6.3	6.6	6.9	6.7	6.9	7.4	7.4
Cond	uS/cm		33	28	28	25	na	77	100	nw	75	75	61	61
uRedox	mV		265	240	240		na	380	380	nw	260	200	210	210
cRedox	mV		505	465	465		na	605	605	nw	485	425	435	435
Temp			*16.6*	*10.5*	*11.5*	*10*		*10*	*8*	*13*	*12*	*13*	*10*	*10*
PHYSICAL														
pH	pH units	0.1	7.1	7	7	6.7	7.7	7.4	7.3	7.3	7.1	7	7.1	7.1
Specific Conductance	uS/cm	1	33	37	37	42	154	109	131	117	106	115	77	77
Residue Nonfilterable (TSS)	mg/L	4										< 4		
Residue Filterable 1.0u (TDS)	mg/L	10		26	26	30		68	72		74	78	44	46
Hardness Total -T	mg/L		12.8	13.6	14.1	42.3	70.1	49.3	58.1	48.6	43.2	46.9	32.8	32.9
Hardness Total -D	mg/L		13.2	13.7	13.6	14.8	73	48.6	59.3	49.7	42.9	47	32.7	32.3
GENERAL INORGANICS														
Acidity pH 4.5	mg/L	0.5		< 0.5	< 0.5	< 0.5		< 0.5	< 0.5		< 0.5	< 0.5	< 0.5	< 0.5
Acidity pH 8.3	mg/L	0.5		1.6	1.6	4.9		1.6	2.5		1.9	2	1.9	2.1
Alkalinity Phen. 8.3 as CaCO3	mg/L	1		< 1.0	< 1.0	< 1.0		< 1.0	< 1.0		< 1.0	< 1.0	< 1.0	< 1.0
Alkalinity Total as CaCO3	mg/L	0.5		6.6	7.7	5.4		23.4	24.7		8.9	8.1	13.6	13.6
Carbonate as CO3=	mg/L			< 0.5	< 0.5	< 0.5		< 0.5	< 0.5		< 0.5	< 0.5	< 0.5	< 0.5
Bicarbonate as HCO3-	mg/L			10.5	9.4	6.6		28.5	30.1		10.8	9.9	16.6	16.6
Hydroxide as OH-	mg/L			< 0.5	< 0.5	< 0.5		< 0.5	< 0.5		< 0.5	< 0.5	< 0.5	< 0.5
Langelier Index	None			-2.6	-2.6	-3.1		-1.4	-1.4		-2.2	-2.3	-2.1	-2.1
Saturation pH	pH units			9.6	9.6	9.6		8.8	8.7		9.3	9.3	9.2	9.2
SULFATE														
Sulfate	mg/L	0.5	6.2	6.6	6.4	19.3	52.4	24.7	33.9	45.5	32	37.4	18	17.5
METALS TOTAL														
Aluminum	mg/L	0.001	0.07	0.065	0.064	17.7	0.04	0.028	0.025	0.04	0.068	0.07	0.066	0.063
Antimony	mg/L	0.001	< 0.05	< 0.001	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.001	< 0.001
Arsenic	mg/L	0.001	< 0.05	< 0.001	< 0.001	0.008	< 0.05	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.004	0.004	0.005	0.085	0.01	0.007	0.008	0.024	0.021	0.022	0.007	0.007
Beryllium	mg/L	0.0002	< 0.0002	< 0.0002	< 0.0002	0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Bismuth	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Boron	mg/L	0.008	0.008	0.015	0.014	0.009	< 0.008	0.029	0.009	0.014	0.029	0.019	< 0.008	< 0.008
Cadmium	mg/L	0.00001	< 0.002	0.00022	0.00022	0.00055	< 0.002	0.00003	0.00005	< 0.002	0.00039	0.00041	0.0001	0.0001
Calcium	mg/L	0.05	4.45	4.82	4.84	7.5	26.5	18.6	21.9	17.7	15.5	16.9	12.2	12.3
Chromium	mg/L	0.001	< 0.005	< 0.001	< 0.001	0.016	< 0.005	< 0.001	< 0.001	< 0.005	< 0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	0.0005	< 0.005	< 0.0005	< 0.0005	0.008	< 0.005	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Copper	mg/L	0.0002	0.029	0.0289	0.0261	0.126	< 0.005	0.0016	0.0017	0.013	0.0152	0.0149	0.0093	0.0097
Iron	mg/L	0.005	0.052	0.036	0.036	17.6	0.006	< 0.005	0.013	0.006	0.021	0.022	0.045	0.04
Lead	mg/L	0.0005	< 0.03	< 0.0005	< 0.0005	0.0343	< 0.03	< 0.0005	< 0.0005	< 0.03	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Magnesium	mg/L	0.05	0.41	0.44	0.48	5.72	0.96	0.7	0.82	1.08	1.09	1.15	0.56	0.54
Manganese	mg/L	0.001	0.001	0.004	0.004	0.447	< 0.001	< 0.001	< 0.001	0.001	0.006	0.006	0.004	0.004
Mercury	mg/L	0.00005		< 0.00005	< 0.00005	< 0.00005		< 0.00005	< 0.00005		< 0.00005	< 0.00005	< 0.00005	< 0.00005
Molybdenum	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Nickel	mg/L	0.008	< 0.008	< 0.008	< 0.008	0.02	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Phosphorus	mg/L	0.1	< 0.1	< 0.1	< 0.1	0.4	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Potassium	mg/L	1	< 1	< 1	< 1	2	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Selenium	mg/L	0.001	< 0.03	< 0.001	< 0.001	< 0.001	< 0.03	< 0.001	< 0.001	< 0.03	< 0.001	< 0.001	< 0.001	< 0.001
Silver	mg/L	0.0001	< 0.01	< 0.0001	< 0.0001	0.0003	< 0.01	< 0.0001	< 0.0001	< 0.01	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium	mg/L	0.05	1.25	1.12	1.14	2.02	1.65	1.25	1.37	2.47	1.95	2.03	1.17	1.17
Strontium	mg/L	0.001	0.015	0.017	0.017	0.045	0.096	0.068	0.081	0.069	0.059	0.063	0.044	0.044
Sulfur	mg/L	0.1	2.2	2.3	2.3	3.4	14.9	8.7	11.5	13.2	11.1	12.5	6.2	6.2
Tellurium	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Thallium	mg/L	0.0001	< 0.03	< 0.0001	< 0.0001	< 0.0001	< 0.03	< 0.0001	< 0.0001	< 0.03	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Tin	mg/L	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Titanium	mg/L	0.003	< 0.003	< 0.003	< 0.003	0.506	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Uranium	mg/L	0.00001		0.00003	0.00003	0.00069		0.00003	< 0.00001		0.00005	< 0.00001	< 0.00001	< 0.00001
Vanadium	mg/L	0.005	< 0.005	< 0.005	< 0.005	0.022	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Zinc	mg/L	0.005	0.022	0.031	0.033	0.138	0.005	0.005	0.006	0.068	0.076	0.063	0.016	0.015
Zirconium	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
METALS DISSOLVED														
Aluminum Dissolved	mg/L	0.001	0.03	0.05	0.054	0.053	0.04	0.031	0.022	0.04	0.062	0.059	0.016	0.016
Antimony Dissolved	mg/L	0.001	< 0.05	< 0.001	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.001	< 0.001
Arsenic Dissolved	mg/L	0.001	< 0.05	< 0.001	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.001	< 0.001
Barium Dissolved	mg/L	0.001	0.004	0.004	0.004	0.005	0.01	0.007	0.007	0.023	0.021	0.022	0.007	0.007
Beryllium Dissolved	mg/L	0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Bismuth Dissolved	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Boron Dissolved	mg/L	0.008	0.011	< 0.008	< 0.008	0.01	< 0.008	< 0.008	< 0.008	0.015	0.029	0.026	< 0.008	< 0.008
Cadmium Dissolved	mg/L	0.00001	< 0.002	0.00026	0.00025	0.00002	< 0.002	0.00004	0.00004	< 0.002	0.00042	0.00046	0.00009	0.00008
Calcium Dissolved	mg/L	0.05	4.56	4.74	4.74	4.68	27.6	18.3	22.4	18.1	15.4	16.9	12.2	12.1
Chromium Dissolved	mg/L	0.001	< 0.025	< 0.001	< 0.001	< 0.001	< 0.005	0.001	< 0.001	< 0.005	< 0.001	< 0.001	< 0.001	< 0.001
Cobalt Dissolved	mg/L	0.0005	< 0.005	< 0.0005	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Copper Dissolved	mg/L	0.0002	0.023	0.0267	0.0266	0.0058	< 0.005	0.0019	0.0015	0.013	0.0145	0.0136	0.0061	0.006
Iron Dissolved	mg/L	0.005	0.019	0.016	0.015	0.044	0.006	0.006	< 0.005	0.005	0.019	0.026	< 0.005	< 0.005
Lead Dissolved	mg/L	0.0005	< 0.03	< 0.0005	< 0.0005	< 0.0005	< 0.03	< 0.0005	< 0.0005	< 0.03	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Magnesium Dissolved	mg/L	0.05	0.43	0.45	0.43	0.75	0.98	0.7	0.81	1.09	1.09	1.17	0.54	0.5
Manganese Dissolved	mg/L	0.001	< 0.001	0.004	0.004	0.022	< 0.001	< 0.001	< 0.001	0.002	0.006	0.006	< 0.001	< 0.001
Mercury Dissolved	mg/L	0.00005		< 0.00005	< 0.00005	< 0.00005		< 0.00005	< 0.00005		< 0.00005	< 0.00005	< 0.00005	< 0.00005
Molybdenum Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Nickel Dissolved	mg/L	0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Phosphorus Dissolved	mg/L	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Potassium Dissolved	mg/L	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Selenium Dissolved	mg/L	0.001	< 0.03	< 0.001	< 0.001	< 0.001	< 0.03	< 0.001	< 0.001	< 0.03	< 0.001	< 0.001	< 0.001	< 0.001
Silver Dissolved	mg/L	0.0001	< 0.01	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.0001	< 0.0001	< 0.01	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Sodium Dissolved	mg/L	0.05	1.3	1.1	1.09	1.47	1.72	1.24	1.35	2.5	1.93	2	1.14	1.13
Strontium Dissolved	mg/L	0.001	0.015	0.016	0.016	0.019	0.096	0.067	0.081	0.068	0.059	0.064	0.042	0.042
Sulfur Dissolved	mg/L	0.1	2.3	2.2	2.3	3.2	15.4	8.6	11.7	13.5	11.3	12.6	6.2	6.2
Tellurium Dissolved	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Thallium Dissolved	mg/L	0.0001	< 0.03	< 0.0001	< 0.0001	< 0.0001	< 0.03	< 0.0001	< 0.0001	< 0.03	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Tin Dissolved	mg/L	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Titanium Dissolved	mg/L	0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Uranium Dissolved	mg/L	0.00001		0.00002	0.00002	0.00002		< 0.00001	0.00003		< 0.00001	< 0.00001	0.00001	< 0.00001
Vanadium Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Zinc Dissolved	mg/L	0.005	0.023	0.033	0.032	< 0.005	0.007	0.005	< 0.005	0.07	0.079	0.064	0.013	0.014
Zirconium Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

Appendix II: 3250 and Receiving Water Monitoring Data

Parameter	Units	Method Detection Limit	Furry d/s			3250						3100		
			17-Aug-04 16:00	29-Sep-04 08:00	05-Oct-04 16:30	03-Jun-04 13:00	13-Aug-04 17:00	28-Sep-04 16:20	29-Sep-04 10:20	03-Oct-04 09:20	05-Oct-04 11:45	13-Aug-04 17:30	28-Sep-04 16:00	05-Oct-04 11:00
FIELD READINGS														
Flow				na	na			3-5	1	0.5				
pH			6.6	6.7	7.0	na	6.9	6.1	4.6	6.7	7.4	7.3	6.5	7.0
Cond	uS/cm		24	23		na	na	224	260	174	184	na	61	109
uRedox	mV		285	225		na	na	180	340	275	210	na	375	405
cRedox	mV		505	450		na	na	405	565	500	435	na	600	630
Temp			17	10	9	na	7	7	7	7	7	7	7	9
PHYSICAL														
pH	pH units	0.1	7.2	7	6.9	7.7	7.7	7.1	4	7	7.4	7.6		
Specific Conductance	uS/cm	1	32	30	32	204	203	322	509	254	240	156		
Residue Nonfilterable (TSS)	mg/L	4				< 4		9	5	< 4	< 4			
Residue Filterable 1.0u (TDS)	mg/L	10		22	26	142		212	350	190	150			
Hardness Total -T	mg/L		12.3	11.4	11.3	95.3	97.5	149	209	116	109	69.6		
Hardness Total -D	mg/L		12.9	11.1	11.8		98.6	149	207	125	113	73.7		
GENERAL INORGANICS														
Acidity pH 4.5	mg/L	0.5		< 0.5	< 0.5	< 0.5		< 0.5	3.7	< 0.5	< 0.5			
Acidity pH 8.3	mg/L	0.5		2	3	1		2.9	26.5	2.4	2.1			
Alkalinity Phen. 8.3 as CaCO3	mg/L	1		< 1.0	< 1.0			< 1.0	< 1.0	< 1.0	< 1.0			
Alkalinity Total as CaCO3	mg/L	0.5		7.9	9.2			21.6	< 0.5	40.9	45.8			
Carbonate as CO3=	mg/L			< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5			
Bicarbonate as HCO3-	mg/L			9.6	11.2			26.3	< 0.5	49.9	55.8			
Hydroxide as OH-	mg/L			< 0.5	< 0.5			< 0.5	< 0.5	< 0.5	< 0.5			
Langelier Index	None			-2.9	-3			-1.3	-5.8	-1.2	-0.6			
Saturation pH	pH units			9.9	9.9			8.4	9.6	8.2	8.2			
SULFATE														
Sulfate	mg/L	0.5	5.9	5.4	3.9	50.4	54.8	123	228	73.3	67.3	37.3		
METALS TOTAL														
Aluminum	mg/L	0.001	0.03	0.03	0.029	0.1	0.38	0.419	2.56	0.067	0.101	0.04		
Antimony	mg/L	0.001	< 0.05	< 0.001	< 0.001	< 0.05	< 0.05	< 0.001	< 0.001	< 0.001	< 0.001	< 0.05		
Arsenic	mg/L	0.001	< 0.05	< 0.001	< 0.001	< 0.05	< 0.05	0.001	0.001	< 0.001	< 0.001	< 0.05		
Barium	mg/L	0.001	0.005	0.005	0.005	0.007	0.007	0.016	0.031	0.009	0.006	0.004		
Beryllium	mg/L	0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0008	< 0.0002	< 0.0002	< 0.0002		
Bismuth	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05		
Boron	mg/L	0.008	< 0.008	0.014	< 0.008	0.01	< 0.008	0.033	0.04	0.017	0.016	0.033		
Cadmium	mg/L	0.00001	< 0.002	0.00004	0.00004	< 0.002	< 0.002	0.00264	0.0134	0.00223	0.00115	< 0.002		
Calcium	mg/L	0.05	4.25	3.92	3.9	35.6	36.4	54.8	75.4	42.7	40.3	26.2		
Chromium	mg/L	0.001	< 0.005	< 0.001	< 0.001	< 0.005	< 0.005	< 0.001	0.001	< 0.001	< 0.001	< 0.005		
Cobalt	mg/L	0.0005	< 0.005	< 0.0005	< 0.0005	< 0.005	0.005	0.0114	0.0298	0.0027	0.0025	< 0.005		
Copper	mg/L	0.0002	< 0.005	0.0044	0.0039	0.008	0.021	0.0299	0.264	0.0132	0.0123	0.015		
Iron	mg/L	0.005	0.007	0.015	0.012	0.539	2.12	3.21	5.79	0.322	0.404	0.02		
Lead	mg/L	0.0005	< 0.03	< 0.0005	< 0.0005	< 0.03	< 0.03	0.0009	0.0036	< 0.0005	< 0.0005	< 0.03		
Magnesium	mg/L	0.05	0.4	0.4	0.37	1.56	1.5	2.88	5.11	2.17	1.97	1.07		
Manganese	mg/L	0.001	< 0.001	< 0.001	< 0.001	0.045	0.094	0.292	0.594	0.074	0.066	0.003		
Mercury	mg/L	0.00005		< 0.00005	< 0.00005			< 0.00005	< 0.00005	< 0.00005	< 0.00005			
Molybdenum	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005		
Nickel	mg/L	0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	0.029	< 0.008	0.008	< 0.008		
Phosphorus	mg/L	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1		
Potassium	mg/L	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1		
Selenium	mg/L	0.001	< 0.03	< 0.001	< 0.001	< 0.03	< 0.03	< 0.001	< 0.001	< 0.001	< 0.001	< 0.03		
Silver	mg/L	0.0001	< 0.01	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01		
Sodium	mg/L	0.05	1.37	1.23	1.16	3.23	3.39	3.71	3.97	3.5	3.3	4.16		
Strontium	mg/L	0.001	0.016	0.015	0.015	0.067	0.09	0.126	0.178	0.109	0.101	0.096		
Sulfur	mg/L	0.1	1.5	1.3	1.4	16.3	16.6	42	75.7	25.6	22.3	10.9		
Tellurium	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05		
Thallium	mg/L	0.0001	< 0.03	< 0.0001	< 0.0001	< 0.03	< 0.03	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.03		
Tin	mg/L	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02		
Titanium	mg/L	0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.007	0.024	< 0.003	< 0.003	< 0.003		
Uranium	mg/L	0.00001		0.00005	0.00002			0.00005	0.00018	0.00002	0.00002			
Vanadium	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005		
Zinc	mg/L	0.005	< 0.005	< 0.005	< 0.005	0.069	0.104	0.263	1.42	0.187	0.145	0.078		
Zirconium	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005		
METALS DISSOLVED														
Aluminum Dissolved	mg/L	0.001	< 0.02	0.031	0.025		< 0.02	0.098	2.69	0.004	0.01	< 0.02		
Antimony Dissolved	mg/L	0.001	< 0.05	< 0.001	< 0.001		< 0.05	< 0.001	< 0.001	< 0.001	< 0.001	< 0.05		
Arsenic Dissolved	mg/L	0.001	< 0.05	< 0.001	< 0.001		< 0.05	< 0.001	< 0.001	< 0.001	< 0.001	< 0.05		
Barium Dissolved	mg/L	0.001	0.006	0.005	0.004		0.006	0.015	0.03	0.009	0.006	0.004		
Beryllium Dissolved	mg/L	0.0002	< 0.0002	< 0.0002	< 0.0002		< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002		
Bismuth Dissolved	mg/L	0.05	< 0.05	< 0.05	< 0.05		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05		
Boron Dissolved	mg/L	0.008	< 0.008	< 0.008	< 0.008		< 0.008	< 0.008	0.026	0.012	0.016	0.034		
Cadmium Dissolved	mg/L	0.00001	< 0.002	0.00007	0.00003		< 0.002	0.00307	0.0147	0.00086	0.00117	< 0.002		
Calcium Dissolved	mg/L	0.05	4.46	3.84	3.85		36.9	54.9	74.8	46.2	41.9	27.7		
Chromium Dissolved	mg/L	0.001	< 0.005	< 0.001	< 0.001		< 0.005	0.002	< 0.001	0.002	< 0.001	< 0.005		
Cobalt Dissolved	mg/L	0.0005	< 0.005	< 0.0005	< 0.0005		< 0.005	0.0121	0.0296	0.0025	0.0026	< 0.005		
Copper Dissolved	mg/L	0.0002	< 0.005	0.0048	0.0037		< 0.005	0.0143	0.281	0.0019	0.0034	0.012		
Iron Dissolved	mg/L	0.005	0.007	0.008	0.01		0.056	0.797	1.13	0.014	0.013	0.011		
Lead Dissolved	mg/L	0.0005	< 0.03	< 0.0005	< 0.0005		< 0.03	< 0.0005	0.0027	< 0.0005	< 0.0005	< 0.03		
Magnesium Dissolved	mg/L	0.05	0.42	0.37	0.52		1.56	2.93	5.03	2.34	2.02	1.11		
Manganese Dissolved	mg/L	0.001	< 0.001	< 0.001	< 0.001		0.044	0.278	0.493	0.076	0.067	0.003		
Mercury Dissolved	mg/L	0.00005		< 0.00005	< 0.00005			< 0.00005	< 0.00005	< 0.00005	< 0.00005			
Molybdenum Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005		< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005		
Nickel Dissolved	mg/L	0.008	< 0.008	< 0.008	< 0.008		< 0.008	< 0.008	0.027	< 0.008	< 0.008	< 0.008		
Phosphorus Dissolved	mg/L	0.1	< 0.1	< 0.1	< 0.1		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1		
Potassium Dissolved	mg/L	1	< 1	< 1	< 1		< 1	< 1	< 1	< 1	< 1	< 1		
Selenium Dissolved	mg/L	0.001	< 0.03	< 0.001	< 0.001		< 0.03	< 0.001	< 0.001	< 0.001	< 0.001	< 0.03		
Silver Dissolved	mg/L	0.0001	< 0.01	< 0.0001	< 0.0001		< 0.01	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01		
Sodium Dissolved	mg/L	0.05	1.52	1.19	1.45		3.37	3.65	3.85	3.72	3.29	4.28		
Strontium Dissolved	mg/L	0.001	0.016	0.015	0.016		0.067	0.126	0.175	0.116	0.102	0.096		
Sulfur Dissolved	mg/L	0.1	1.5	1.2	1.6		16.5	43.1	74.6	26.4	23.1	11.3		
Tellurium Dissolved	mg/L	0.05	< 0.05	< 0.05	< 0.05		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05		
Thallium Dissolved	mg/L	0.0001	< 0.03	< 0.0001	< 0.0001		< 0.03	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.03		
Tin Dissolved	mg/L	0.02	< 0.02	< 0.02	< 0.02		< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02		
Titanium Dissolved	mg/L	0.003	< 0.003	< 0.003	< 0.003		< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003		
Uranium Dissolved	mg/L	0.00001		0.00003	0.00003			0.00001	0.00016	< 0.00001	0.00003			
Vanadium Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005		< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005		
Zinc Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005		0.066	0.296	1.41	0.179	0.148	0.063		
Zirconium Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005		< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005		

Appendix III

4100 Drainage Chemistry

Appendix II 4100 Drainage Chemistry

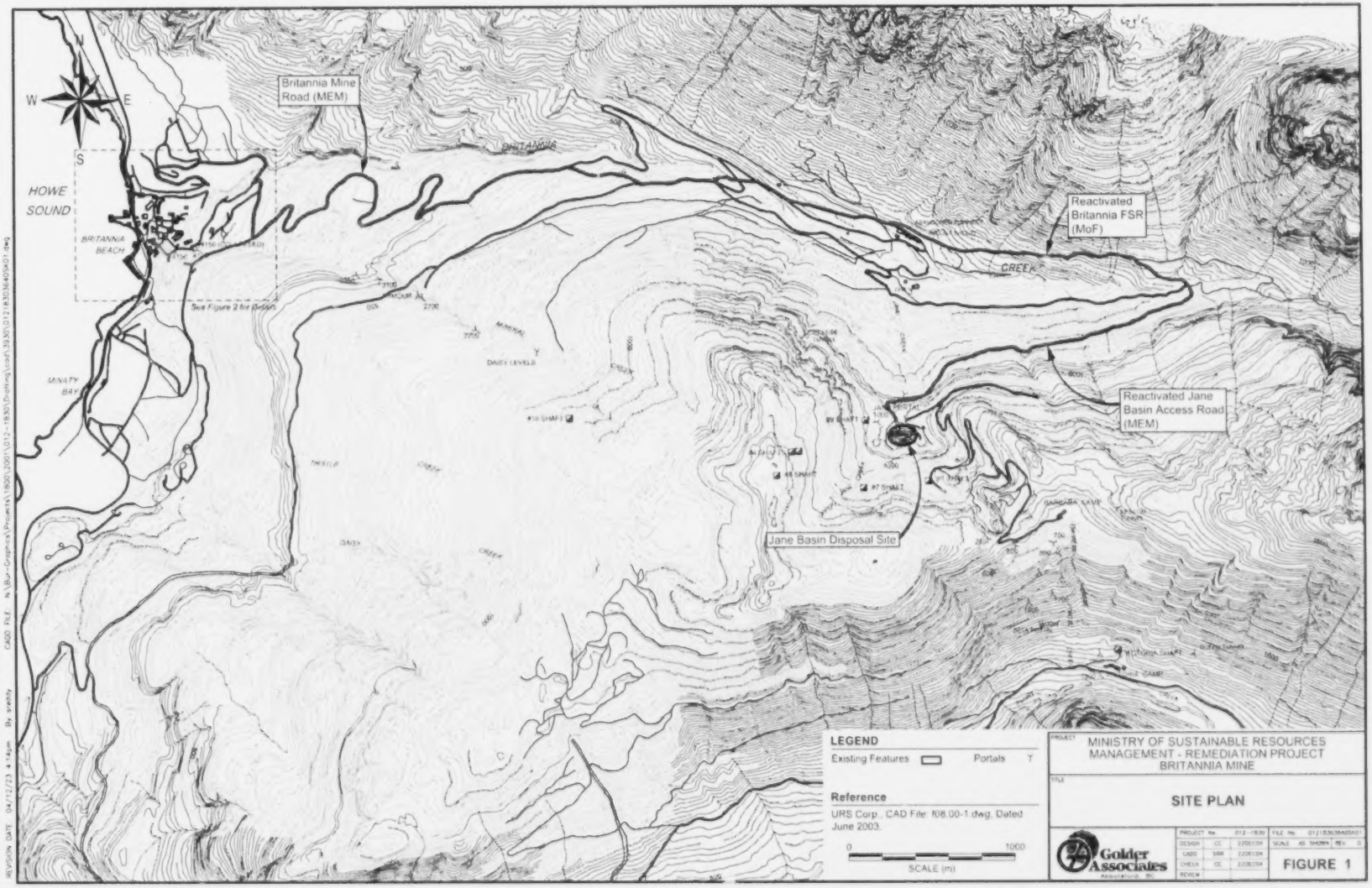
Parameter	Units	Method Detection Limit	28-Sep-04 18:00	29-Sep-04 14:20	30-Sep-04 14:35	01-Oct-04 9:00	02-Oct-04 8:30	03-Oct-04 9:22	04-Oct-04 15:15	05-Oct-04 14:00	06-Oct-04 16:00	07-Oct-04 14:00	08-Oct-04 16:00
FIELD READINGS													
pH			4.1	4.4	4.2	4.0	3.7	3.8	3.5	3.6	3.3	3.3	3.3
Cond	µS/cm		1410	995	1600	1600	1590	1570	1760	1930	1600	2000	2030
uRedox	mV		365	310	360	390	445	375	400	410	510	425	425
cRedox	mV		590	535	585	615	670	600	625	635	735	650	650
Temp	°C		12.5	12.5	12.0	12.0	12.5	12.5	12.5	12.5	13.0	12.5	13.0
Field Cu1	mg/L		14.5	16.3	36.5	27.3	28.1	28.3	34.3	48.5	45.3	43.0	47.0
Field Cu2	mg/L		13.9	16.0	37.5	28.0	26.0	27.6	36.0	43.6	42.5	43.3	48.3
Avg Field Cu	mg/L		14	16	37	28	27	28	35	46	44	43	48
PHYSICAL													
pH	pH units	0.1	3.8				3.6			3.2			3.1
Specific Conductance	µS/cm	1	2330				2510			3010			3280
Residue Nonfilterable (TSS)	mg/L	4	7				15			24			47
Residue Filterable 1.0u (TDS)	mg/L	10	2250				2580			3080			3650
Hardness Total -D	mg/L		1410		1510		1530		1590	1500		1750	1720
Hardness Total -T	mg/L		1400				1480			1620			1710
GENERAL INORGANICS													
Acidity pH 4.5	mg/L	0.5	16.1				28.6			155			265
Acidity pH 8.3	mg/L	0.5	138				223			485			722
Alkalinity Phen. 8.3 as CaCO3	mg/L		< 1.0				< 1.0			< 1.0			
Alkalinity Total as CaCO3	mg/L		< 0.5				< 0.5			< 0.5			
Carbonate as CO3=	mg/L		< 0.5				< 0.5			< 0.5			
Bicarbonate as HCO3-	mg/L		< 0.5				< 0.5			< 0.5			
Hydroxide as OH-	mg/L		< 0.5				< 0.5			< 0.5			
Langelier Index	none		-5.1				-5.3			-5.8			
Saturation pH	pH units		8.9				8.9			9			
SULFATE													
Sulfate	mg/L	0.5	1470				1570			1930			2400
METALS TOTAL													
Aluminum	mg/L	0.02	12.3				21.3			41.3			60.6
Antimony	mg/L	0.05	< 0.05				< 0.05			< 0.05			< 0.05
Arsenic	mg/L	0.05	< 0.05				< 0.05			< 0.05			< 0.05
Barium	mg/L	0.001	0.008				0.008			0.007			0.007
Beryllium	mg/L	0.0002	0.0012				0.0019			0.0033			0.0051
Bismuth	mg/L	0.05	< 0.05				< 0.05			< 0.05			< 0.05
Boron	mg/L	0.008	0.211				0.186			0.2			0.242
Cadmium	mg/L	0.002	0.094				0.13			0.1			0.09
Calcium	mg/L	0.05	452				467			442			470
Chromium	mg/L	0.005	< 0.005				< 0.005			0.009			0.013
Cobalt	mg/L	0.005	0.061				0.073			0.134			0.207
Copper	mg/L	0.005	14.3				28.5			42.5			53
Iron	mg/L	0.005	9.29				9.91			65.6			112
Lead	mg/L	0.03	0.03				0.06			0.05			0.05
Magnesium	mg/L	0.05	69.1				76.7			97			130
Manganese	mg/L	0.001	5.82				6.67			7.58			9.79
Molybdenum	mg/L	0.005	< 0.005				< 0.005			< 0.005			< 0.005
Nickel	mg/L	0.008	0.041				0.046			0.087			0.126
Phosphorus	mg/L	0.1	< 0.1				< 0.1			< 0.1			< 0.1
Potassium	mg/L	1	1				1			1			< 1
Selenium	mg/L	0.03	< 0.03				< 0.03			< 0.03			< 0.03
Silver	mg/L	0.01	< 0.01				< 0.01			< 0.01			< 0.01
Sodium	mg/L	0.05	12.7				10.1			10.3			11.8
Strontium	mg/L	0.001	2.31				2.47			2.39			2.5
Sulfur	mg/L	0.1	529				599			649			837
Tellurium	mg/L	0.05	< 0.05				< 0.05			< 0.05			< 0.05
Thallium	mg/L	0.03	< 0.03				< 0.03			< 0.03			< 0.03
Tin	mg/L	0.02	< 0.02				< 0.02			< 0.02			< 0.02
Titanium	mg/L	0.003	< 0.003				< 0.003			< 0.003			< 0.003
Vanadium	mg/L	0.005	< 0.005				< 0.005			< 0.005			< 0.005
Zinc	mg/L	0.005	21.8				27.4			22.3			20.8
Zirconium	mg/L	0.005	< 0.005				< 0.005			< 0.005			< 0.005
METALS DISSOLVED													
Aluminum Dissolved	mg/L	0.02	12.1		22		22.2		33.7	43.5		54.4	59.7
Antimony Dissolved	mg/L	0.05	< 0.05		< 0.05		< 0.05		< 0.05	< 0.05		< 0.05	< 0.05
Arsenic Dissolved	mg/L	0.05	0.06		< 0.05		< 0.05		< 0.05	< 0.05		< 0.05	0.05
Barium Dissolved	mg/L	0.001	0.008		0.008		0.008		0.007	0.008		0.007	0.007
Beryllium Dissolved	mg/L	0.0002	0.0012		0.0022		0.0019		0.0029	0.0035		0.0046	0.0052
Bismuth Dissolved	mg/L	0.05	< 0.05		< 0.05		< 0.05		< 0.05	< 0.05		< 0.05	< 0.05
Boron Dissolved	mg/L	0.008	0.212		0.195		0.191		0.208	0.218		0.236	0.233
Cadmium Dissolved	mg/L	0.002	0.094		0.131		0.134		0.121	0.109		0.102	0.094
Calcium Dissolved	mg/L	0.05	448		473		480		485	479		498	476
Chromium Dissolved	mg/L	0.005	< 0.005		< 0.005		< 0.005		0.007	0.008		0.011	0.014
Cobalt Dissolved	mg/L	0.005	0.061		0.079		0.075		0.119	0.148		0.19	0.213
Copper Dissolved	mg/L	0.005	14.1		40.8		29.9		37.4	44.5		49	53.5
Iron Dissolved	mg/L	0.005	7.72		23.2		7.59		38.1	65.2		92.4	106
Lead Dissolved	mg/L	0.03	0.04		0.03		0.03		0.05	0.06		0.06	0.05
Magnesium Dissolved	mg/L	0.05	68.3		80.1		80.4		92.9	104		124	130
Manganese Dissolved	mg/L	0.001	5.75		6.87		6.89		7.64	8.21		9.56	9.87
Molybdenum Dissolved	mg/L	0.005	< 0.005		< 0.005		< 0.005		< 0.005	< 0.005		< 0.005	< 0.005
Nickel Dissolved	mg/L	0.008	0.044		0.045		0.05		0.071	0.088		0.116	0.127
Phosphorus Dissolved	mg/L	0.1	< 0.1		< 0.1		< 0.1		< 0.1	< 0.1		< 0.1	< 0.1
Potassium Dissolved	mg/L	1	1		< 1		1		1	1		1	2
Selenium Dissolved	mg/L	0.03	< 0.03		< 0.03		< 0.03		< 0.03	< 0.03		< 0.03	< 0.03
Silver Dissolved	mg/L	0.01	< 0.01		< 0.01		< 0.01		< 0.01	< 0.01		< 0.01	< 0.01
Sodium Dissolved	mg/L	0.05	12.5		10.8		9.94		11	11.2		12.6	12.2
Strontium Dissolved	mg/L	0.001	2.28		2.49		2.58		2.51	2.49		2.65	2.48
Sulfur Dissolved	mg/L	0.1	520		605		592		669	731		817	863
Tellurium Dissolved	mg/L	0.05	< 0.05		< 0.05		< 0.05		< 0.05	< 0.05		< 0.05	< 0.05
Thallium Dissolved	mg/L	0.03	< 0.03		< 0.03		< 0.03		< 0.03	< 0.03		< 0.03	< 0.03
Tin Dissolved	mg/L	0.02	< 0.02		< 0.02		< 0.02		< 0.02	< 0.02		< 0.02	< 0.02
Titanium Dissolved	mg/L	0.003	< 0.003		< 0.003		< 0.003		< 0.003	< 0.003		< 0.003	< 0.003
Vanadium Dissolved	mg/L	0.005	< 0.005		< 0.005		< 0.005		< 0.005	< 0.005		< 0.005	< 0.005
Zinc Dissolved	mg/L	0.005	21.5		29.7		28.6		26	24.1		22.6	20.6
Zirconium Dissolved	mg/L	0.005	< 0.005		< 0.005		< 0.005		< 0.005	< 0.005		< 0.005	< 0.005

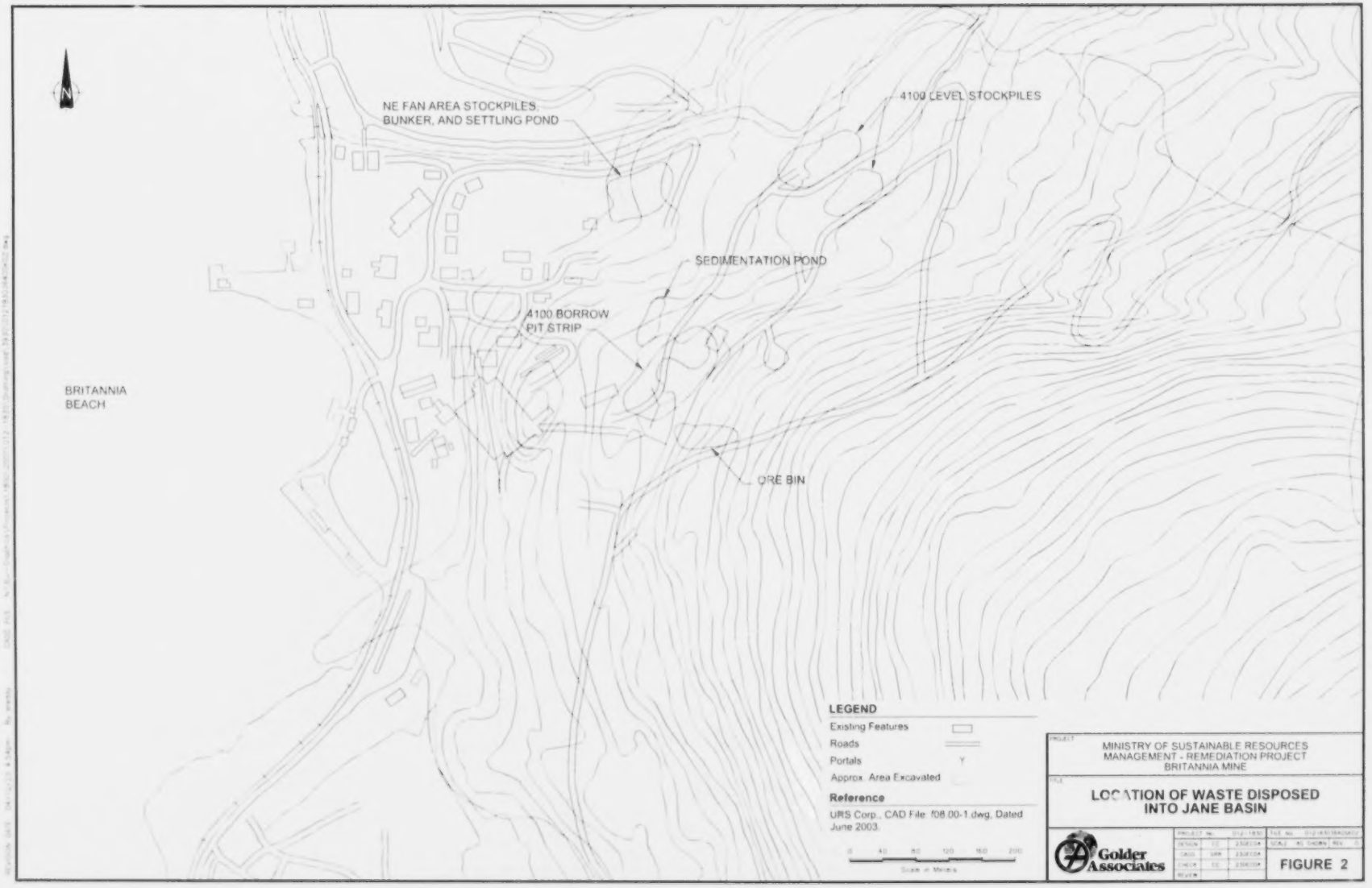
Appendix III: 4100 Drainage Chemistry

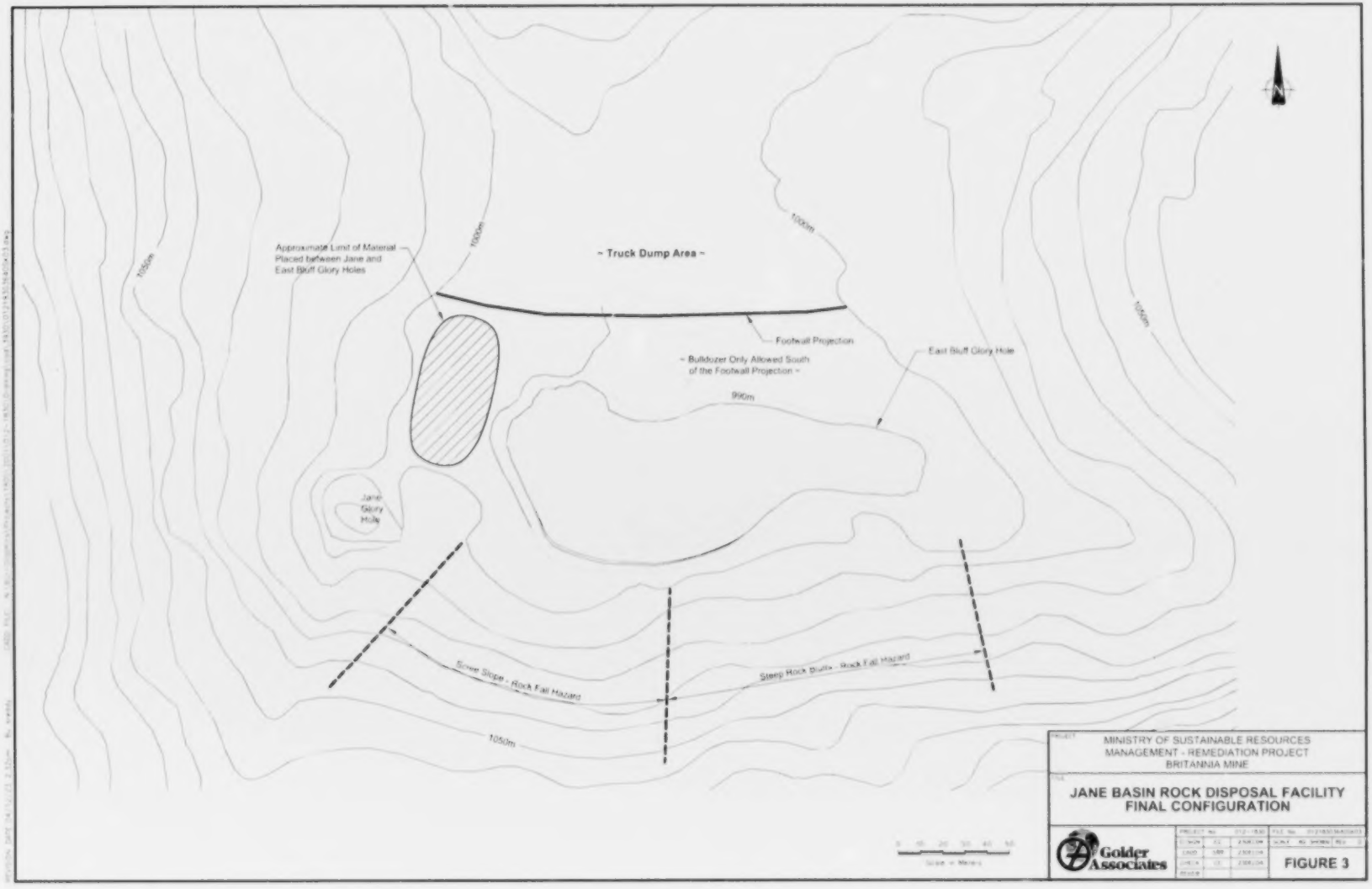
Parameter	Units	Method Detection Limit	09-Oct-04 10:00	11-Oct-04 15:00	12-Oct-04 17:00	13-Oct-04 15:00	14-Oct-04 17:00	15-Oct-04 13:30	16-Oct-04 15:30	18-Oct-04 12:00	20-Oct-04 14:00	22-Oct-04 12:00
FIELD READINGS												
pH			3.3	3.3	3.3	3.3	3.5	3.5	3.5	3.5	3.4	3.6
Cond	µS/cm		3170	3210	3270	3350	3220	3210	3220	3170	3040	2850
uRedox	mV		430	400	410	410	410	410	405	405	405	410
cRedox	mV		655	625	635	635	635	635	630	630	630	635
Temp	°C		13.0	14.0	13.0	13.0	13.0	?	13.0	13.0	13.0	13.0
Field Cu1	mg/L		43.7	41.0	41.5	46.2	40.8	37.3	38.2	38.2	32.8	25.2
Field Cu2	mg/L		44.0	42.7	41.8	45.8	40.2	37.3	38.2	37.8	32.3	25.3
Avg Field Cu	mg/L		44	42	42	46	41	37	38	38	33	25
PHYSICAL												
pH	pH units	0.1			3.2				3.1		3.2	
Specific Conductance	µS/cm	1			3110				3210		2990	
Residue Nonfilterable (TSS)	mg/L	4			22				9		33	
Residue Filterable 1.0u (TDS)	mg/L	10			3540				3470		3190	
Hardness Total -D	mg/L		1620	1670	1760		1830		1800		1680	
Hardness Total -T	mg/L				1740				1700		1640	
GENERAL INORGANICS												
Acidity pH 4.5	mg/L	0.5			250				240		199	
Acidity pH 8.3	mg/L	0.5			675				639		551	
Alkalinity Phen. 8.3 as CaCO3	mg/L											
Alkalinity Total as CaCO3	mg/L											
Carbonate as CO3=	mg/L											
Bicarbonate as HCO3-	mg/L											
Hydroxide as OH-	mg/L											
Langelier Index	none											
Saturation pH	pH units											
SULFATE												
Sulfate	mg/L	0.5			2280				2300		1990	
METALS TOTAL												
Aluminum	mg/L	0.02			60.3				55.9		49	
Antimony	mg/L	0.05			< 0.05				< 0.05		< 0.05	
Arsenic	mg/L	0.05			< 0.05				< 0.05		< 0.05	
Barium	mg/L	0.001			0.007				0.007		0.006	
Beryllium	mg/L	0.0002			0.0053				0.0047		0.0043	
Bismuth	mg/L	0.05			< 0.05				< 0.05		< 0.05	
Boron	mg/L	0.008			0.271				0.293		0.281	
Cadmium	mg/L	0.002			0.088				0.081		0.082	
Calcium	mg/L	0.05			475				470		462	
Chromium	mg/L	0.005			0.015				0.013		0.01	
Cobalt	mg/L	0.005			0.212				0.192		0.175	
Copper	mg/L	0.005			45.9				41.7		34.2	
Iron	mg/L	0.005			113				111		60	
Lead	mg/L	0.03			0.07				0.04		0.05	
Magnesium	mg/L	0.05			134				126		119	
Manganese	mg/L	0.001			10.4				9.93		9.41	
Molybdenum	mg/L	0.005			0.006				< 0.005		< 0.005	
Nickel	mg/L	0.008			0.133				0.131		0.106	
Phosphorus	mg/L	0.1			< 0.1				< 0.1		< 0.1	
Potassium	mg/L	1			2				1		2	
Selenium	mg/L	0.03			< 0.03				< 0.03		< 0.03	
Silver	mg/L	0.01			< 0.01				< 0.01		< 0.01	
Sodium	mg/L	0.05			14.4				16.4		17.5	
Strontium	mg/L	0.001			2.68				2.74		2.63	
Sulfur	mg/L	0.1			759				827		762	
Tellurium	mg/L	0.05			< 0.05				< 0.05		< 0.05	
Thallium	mg/L	0.03			< 0.03				< 0.03		< 0.03	
Tin	mg/L	0.02			< 0.02				< 0.02		< 0.02	
Titanium	mg/L	0.003			< 0.003				< 0.003		< 0.003	
Vanadium	mg/L	0.005			< 0.005				< 0.005		< 0.005	
Zinc	mg/L	0.005			20.1				18.5		18.4	
Zirconium	mg/L	0.005			< 0.005				< 0.005		< 0.005	
METALS DISSOLVED												
Aluminum Dissolved	mg/L	0.02	51.4	53	60.3		64		58.6		50.2	
Antimony Dissolved	mg/L	0.05	< 0.05	< 0.05	< 0.05		< 0.05		< 0.05		< 0.05	
Arsenic Dissolved	mg/L	0.05	0.06	< 0.05	< 0.05		< 0.05		< 0.05		< 0.05	
Barium Dissolved	mg/L	0.001	0.006	0.007	0.007		0.008		0.007		0.007	
Beryllium Dissolved	mg/L	0.0002	0.0046	0.0046	0.0053		0.0056		0.0051		0.0045	
Bismuth Dissolved	mg/L	0.05	< 0.05	< 0.05	< 0.05		< 0.05		< 0.05		< 0.05	
Boron Dissolved	mg/L	0.008	0.228	0.24	0.259		0.297		0.3		0.304	
Cadmium Dissolved	mg/L	0.002	0.086	0.089	0.09		0.086		0.087		0.083	
Calcium Dissolved	mg/L	0.05	454	466	483		496		497		472	
Chromium Dissolved	mg/L	0.005	0.013	0.013	0.013		0.011		0.014		0.011	
Cobalt Dissolved	mg/L	0.005	0.194	0.195	0.215		0.223		0.206		0.18	
Copper Dissolved	mg/L	0.005	41.7	41.2	45.4		46.4		43.8		34.9	
Iron Dissolved	mg/L	0.005	93.7	94.4	112		121		112		66.6	
Lead Dissolved	mg/L	0.03	0.06	0.06	0.06		0.04		0.06		0.05	
Magnesium Dissolved	mg/L	0.05	119	122	135		143		135		121	
Manganese Dissolved	mg/L	0.001	9.31	9.68	10.4		11.1		10.5		9.65	
Molybdenum Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005		< 0.005		< 0.005		< 0.005	
Nickel Dissolved	mg/L	0.008	0.116	0.119	0.138		0.14		0.127		0.112	
Phosphorus Dissolved	mg/L	0.1	< 0.1	< 0.1	< 0.1		< 0.1		< 0.1		< 0.1	
Potassium Dissolved	mg/L	1	2	2	2		1		2		2	
Selenium Dissolved	mg/L	0.03	< 0.03	< 0.03	< 0.03		< 0.03		< 0.03		< 0.03	
Silver Dissolved	mg/L	0.01	< 0.01	< 0.01	< 0.01		< 0.01		< 0.01		< 0.01	
Sodium Dissolved	mg/L	0.05	12	13.2	14.3		16.2		17.3		18	
Strontium Dissolved	mg/L	0.001	2.36	2.48	2.63		2.8		2.83		2.72	
Sulfur Dissolved	mg/L	0.1	858	864	870		851		822		770	
Tellurium Dissolved	mg/L	0.05	< 0.05	< 0.05	< 0.05		< 0.05		< 0.05		< 0.05	
Thallium Dissolved	mg/L	0.03	< 0.03	< 0.03	< 0.03		< 0.03		< 0.03		< 0.03	
Tin Dissolved	mg/L	0.02	< 0.02	< 0.02	< 0.02		< 0.02		< 0.02		< 0.02	
Titanium Dissolved	mg/L	0.003	< 0.003	< 0.003	< 0.003		< 0.003		< 0.003		< 0.003	
Vanadium Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005		< 0.005		< 0.005		< 0.005	
Zinc Dissolved	mg/L	0.005	19.1	19.9	20.4		20		19.7		18.7	
Zirconium Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005		< 0.005		< 0.005		< 0.005	

Appendix III: 4100 Drainage Chemistry

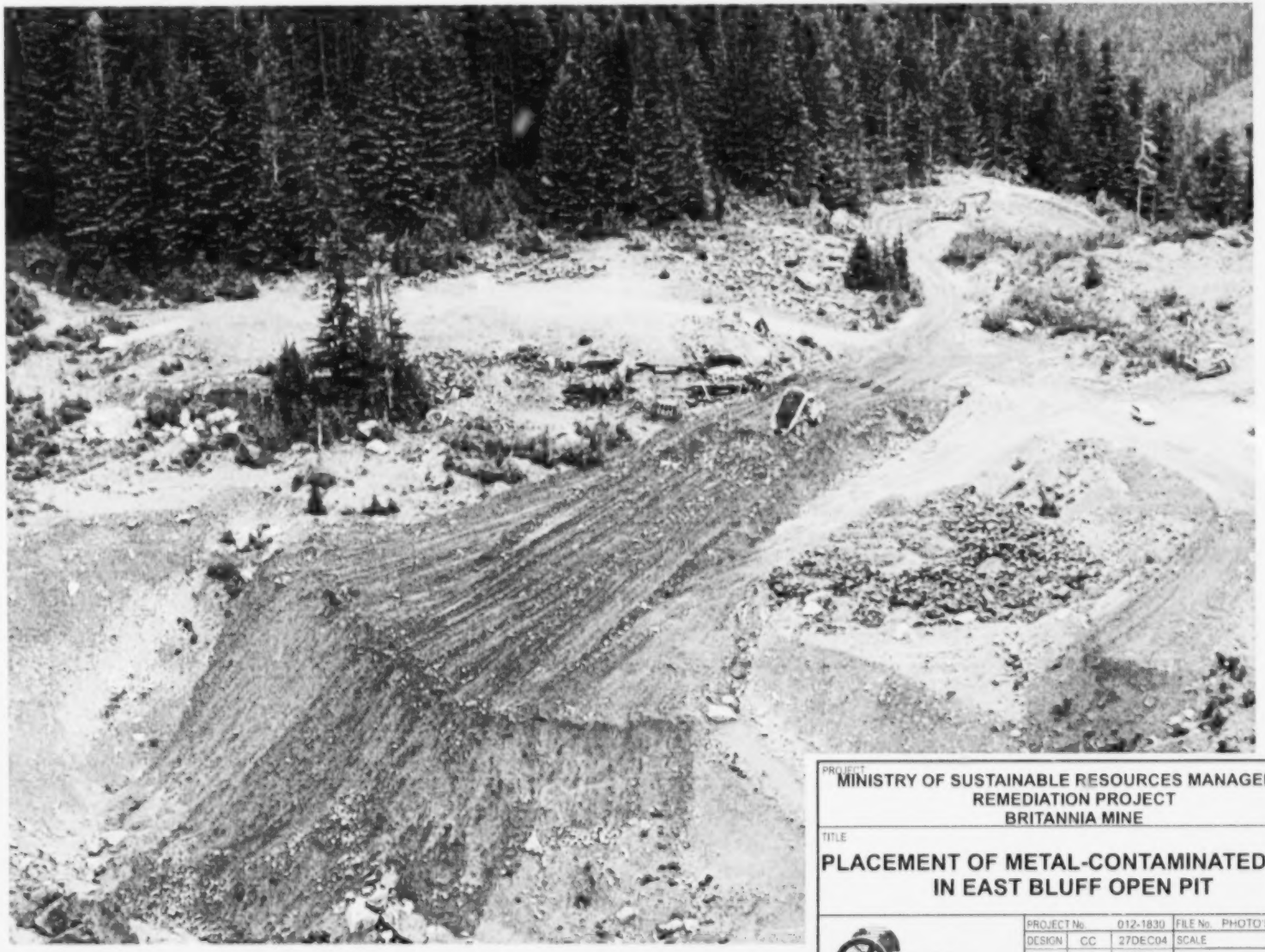
Parameter	Units	Method Detection Limit	24-Oct-04 9:00	26-Oct-04 14:15	28-Oct-04 11:45	01-Nov-04 12:00	05-Nov-04 15:00	08-Nov-04 11:30	12-Nov-04 12:00	15-Nov-04 11:30	22-Nov-04 11:15	29-Nov-04 11:15
FIELD READINGS												
pH			3.5	3.5	3.5	3.7	3.7	3.1	3	3.2	3.5	4.3
Cond	µS/cm		2710	2840	2430	2390	2210	2270	1835			1944
uRedox	mV		410	405	405	435	455	460	545	530	540	535
cRedox	mV		635	630	630	660	680	685	770	755	765	760
Temp	°C			12.0	11.5	11	11	11	11	11	10	
Field Cu1	mg/L		22.9	24.0	26.7	28.3	27.8	28	33.2	29.2	20	
Field Cu2	mg/L		21.9	23.3	26.2	28.3	27.3	28.2	33.3	29	19.8	
Avg Field Cu	mg/L		22	24	26	28	28	28	33	29	20	
PHYSICAL												
pH	pH units	0.1	3.3		3.3	3.3		3.3		3.3	3.8	3.8
Specific Conductance	µS/cm	1	2880		2930	2840		2600		2210	2010	1980
Residue Nonfilterable (TSS)	mg/L	4	15		37	9		6		6	8	6
Residue Filterable 1.0u (TDS)	mg/L	10	2890		3070	3060		2630		2190	1390	1960
Hardness Total -D	mg/L		1590		1690	1450		1430		1170	1140	1140
Hardness Total -T	mg/L				1690	1550						
GENERAL INORGANICS												
Acidity pH 4.5	mg/L	0.5	93.8		152	123		120		69.1	20.5	21.3
Acidity pH 8.3	mg/L	0.5	373		469	504		428		325	202	195
Alkalinity Phen. 8.3 as CaCO3	mg/L											
Alkalinity Total as CaCO3	mg/L											
Carbonate as CO3=	mg/L											
Bicarbonate as HCO3-	mg/L											
Hydroxide as OH-	mg/L											
Langelier Index	none											
Saturation pH	pH units											
SULFATE												
Sulfate	mg/L	0.5	1600		2100	2010		1790		1420	1320	1470
METALS TOTAL												
Aluminum	mg/L	0.02			50.2	48.1						
Antimony	mg/L	0.05			< 0.05	< 0.05						
Arsenic	mg/L	0.05			< 0.05	< 0.05						
Barium	mg/L	0.001			0.007	0.006						
Beryllium	mg/L	0.0002			0.0049	0.0046						
Bismuth	mg/L	0.05			< 0.05	< 0.05						
Boron	mg/L	0.008			0.341	0.291						
Cadmium	mg/L	0.002			0.078	0.071						
Calcium	mg/L	0.05			470	399						
Chromium	mg/L	0.005			0.009	0.007						
Cobalt	mg/L	0.005			0.188	0.165						
Copper	mg/L	0.005			29.7	28.3						
Iron	mg/L	0.005			59.3	41.8						
Lead	mg/L	0.03			0.05	0.03						
Magnesium	mg/L	0.05			125	111						
Manganese	mg/L	0.001			9.69	8.18						
Molybdenum	mg/L	0.005			< 0.005	< 0.005						
Nickel	mg/L	0.008			0.119	0.109						
Phosphorus	mg/L	0.1			< 0.1	< 0.1						
Potassium	mg/L	1			1	1						
Selenium	mg/L	0.03			< 0.03	< 0.03						
Silver	mg/L	0.01			< 0.01	< 0.01						
Sodium	mg/L	0.05			20.2	17.1						
Strontium	mg/L	0.001			2.79	2.27						
Sulfur	mg/L	0.1			758	720						
Tellurium	mg/L	0.05			< 0.05	< 0.05						
Thallium	mg/L	0.03			< 0.03	< 0.03						
Tin	mg/L	0.02			< 0.02	< 0.02						
Titanium	mg/L	0.003			< 0.003	< 0.003						
Vanadium	mg/L	0.005			< 0.005	< 0.005						
Zinc	mg/L	0.005			17.6	15.2						
Zirconium	mg/L	0.005			< 0.005	< 0.005						
METALS DISSOLVED												
Aluminum Dissolved	mg/L	0.02	35.9		49.6	51.2		46.3		34.1	21.4	22.6
Antimony Dissolved	mg/L	0.05	< 0.05		< 0.05	< 0.05		< 0.05		< 0.05	< 0.05	< 0.05
Arsenic Dissolved	mg/L	0.05	< 0.05		< 0.05	< 0.05		< 0.05		< 0.05	< 0.05	< 0.05
Barium Dissolved	mg/L	0.001	0.007		0.007	0.006		0.007		0.007	0.006	0.008
Beryllium Dissolved	mg/L	0.0002	0.0034		0.0049	0.0048		0.0039		0.0022	0.0014	0.0015
Bismuth Dissolved	mg/L	0.05	< 0.05		< 0.05	< 0.05		< 0.05		< 0.05	< 0.05	< 0.05
Boron Dissolved	mg/L	0.008	0.295		0.323	0.306		0.265		0.172	0.154	0.159
Cadmium Dissolved	mg/L	0.002	0.083		0.08	0.076		0.097		0.106	0.066	0.091
Calcium Dissolved	mg/L	0.05	467		471	426		401		348	357	358
Chromium Dissolved	mg/L	0.005	0.005		0.01	0.009		0.007		0.006	< 0.005	0.006
Cobalt Dissolved	mg/L	0.005	0.141		0.185	0.173		0.15		0.09	0.06	0.063
Copper Dissolved	mg/L	0.005	23.4		29	30.3		29.5		30.8	21.5	22.3
Iron Dissolved	mg/L	0.005	37.2		57.7	25.9		25.1		7.23	1.11	1.42
Lead Dissolved	mg/L	0.03	0.07		0.06	0.03		0.05		0.06	0.03	0.06
Magnesium Dissolved	mg/L	0.05	103		125	119		105		74.2	59.7	60.9
Manganese Dissolved	mg/L	0.001	8.27		9.65	8.71		7.41		5.08	4.1	4.13
Molybdenum Dissolved	mg/L	0.005	< 0.005		< 0.005	< 0.005		< 0.005		< 0.005	< 0.005	< 0.005
Nickel Dissolved	mg/L	0.008	0.09		0.12	0.111		0.093		0.062	0.043	0.042
Phosphorus Dissolved	mg/L	0.1	< 0.1		< 0.1	< 0.1		< 0.1		< 0.1	< 0.1	< 0.1
Potassium Dissolved	mg/L	1	2		2	< 1		1		1	< 1	1
Selenium Dissolved	mg/L	0.03	< 0.03		< 0.03	< 0.03		< 0.03		< 0.03	< 0.03	0.04
Silver Dissolved	mg/L	0.01	< 0.01		< 0.01	< 0.01		< 0.01		< 0.01	< 0.01	< 0.01
Sodium Dissolved	mg/L	0.05	18		19.7	18.5		17.1		10.2	9.13	9.32
Strontium Dissolved	mg/L	0.001	2.71		2.71	2.41		2.15		1.76	1.89	1.91
Sulfur Dissolved	mg/L	0.1	692		760	706		641		531	456	454
Tellurium Dissolved	mg/L	0.05	< 0.05		< 0.05	< 0.05		< 0.05		< 0.05	< 0.05	< 0.05
Thallium Dissolved	mg/L	0.03	< 0.03		< 0.03	< 0.03		< 0.03		< 0.03	< 0.03	< 0.03
Tin Dissolved	mg/L	0.02	< 0.02		< 0.02	< 0.02		< 0.02		< 0.02	< 0.02	< 0.02
Titanium Dissolved	mg/L	0.003	< 0.003		< 0.003	< 0.003		< 0.003		< 0.003	< 0.003	< 0.003
Vanadium Dissolved	mg/L	0.005	< 0.005		< 0.005	< 0.005		< 0.005		< 0.005	< 0.005	< 0.005
Zinc Dissolved	mg/L	0.005	18.8		17.7	16.4		19.8		22.7	19	19.9
Zirconium Dissolved	mg/L	0.005	< 0.005		< 0.005	< 0.005		< 0.005		< 0.005	< 0.005	< 0.005


Britannia Mine Road (MEM)
HOWE SOUND
BRITANNIA BEACH
See Figure 2 for Detail
MINATY BAY
BRITANNIA
CREEK
Reactivated Britannia FSR (MoF)
Reactivated Jane Basin Access Road (MEM)
Jane Basin Disposal Site
LEGEND
Existing Features
Portals
Reference
URS Corp., CAD File: f08.00-1.dwg, Dated June 2003.
0
1000
SCALE (m)
MINISTRY OF SUSTAINABLE RESOURCES MANAGEMENT - REMEDIATION PROJECT
BRITANNIA MINE
SITE PLAN
Golder Associates
FIGURE 1


N
NE FAN AREA STOCKPILES, BUNKER, AND SETTLING POND
4100 LEVEL STOCKPILES
SEDIMENTATION POND
4100 BORROW PIT STRIP
BRITANNIA BEACH
ORE BIN
LEGEND
Existing Features
Roads
Portals
Approx. Area Excavated
Reference
URS Corp., CAD File: f08.00-1.dwg, Dated June 2003.
0 40 80 120 160 200
Scale in Metres
PROJECT
MINISTRY OF SUSTAINABLE RESOURCES MANAGEMENT - REMEDIATION PROJECT BRITANNIA MINE
TITLE
LOCATION OF WASTE DISPOSED INTO JANE BASIN
Golder Associates
FIGURE 2


Approximate Limit of Material Placed between Jane and East Bluff Glory Holes
~ Truck Dump Area ~
1050m
1000m
1000m
1050m
Footwall Projection
East Bluff Glory Hole
~ Bulldozer Only Allowed South of the Footwall Projection ~
990m
Jane Glory Hole
Steep Slope - Rock Fall Hazard
Steep Rock Bluffs - Rock Fall Hazard
1050m
N
MINISTRY OF SUSTAINABLE RESOURCES MANAGEMENT - REMEDIATION PROJECT
BRITANNIA MINE
JANE BASIN ROCK DISPOSAL FACILITY
FINAL CONFIGURATION
Golder Associates
FIGURE 3

DRAWING DATE: 28-Dec-04 COREL FILE: N:\Bur-Graphics\Projects\1800\2001\012-1830\Drafting\corel\Photo's.cdr



PROJECT
MINISTRY OF SUSTAINABLE RESOURCES MANAGEMENT
REMEDIATION PROJECT
BRITANNIA MINE

TITLE
PLACEMENT OF METAL-CONTAMINATED SOIL IN EAST BLUFF OPEN PIT

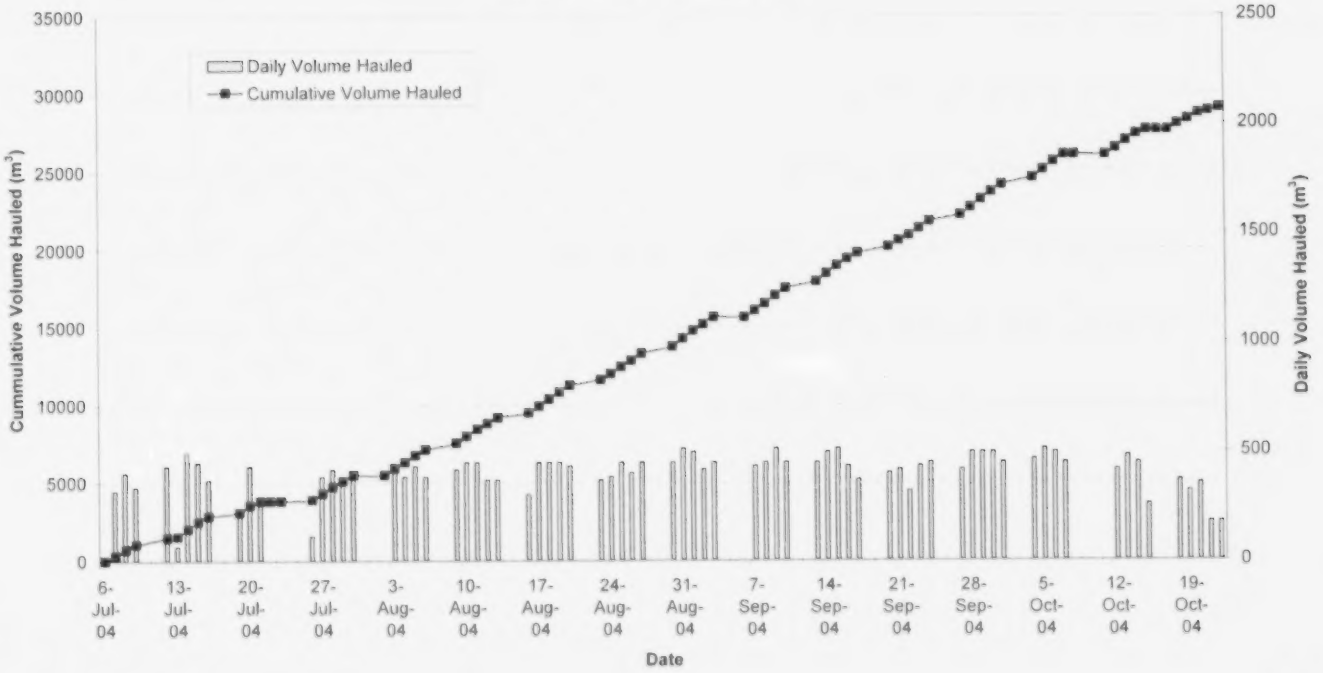
Golder Associates

PROJECT No.		012-1830	FILE No. PHOTO'S	
DESIGN	CC	27DEC04	SCALE	REV.
CADD	SS	27DEC04	FIGURE 4	
CHECK	CC	27DEC04		
REVIEW				

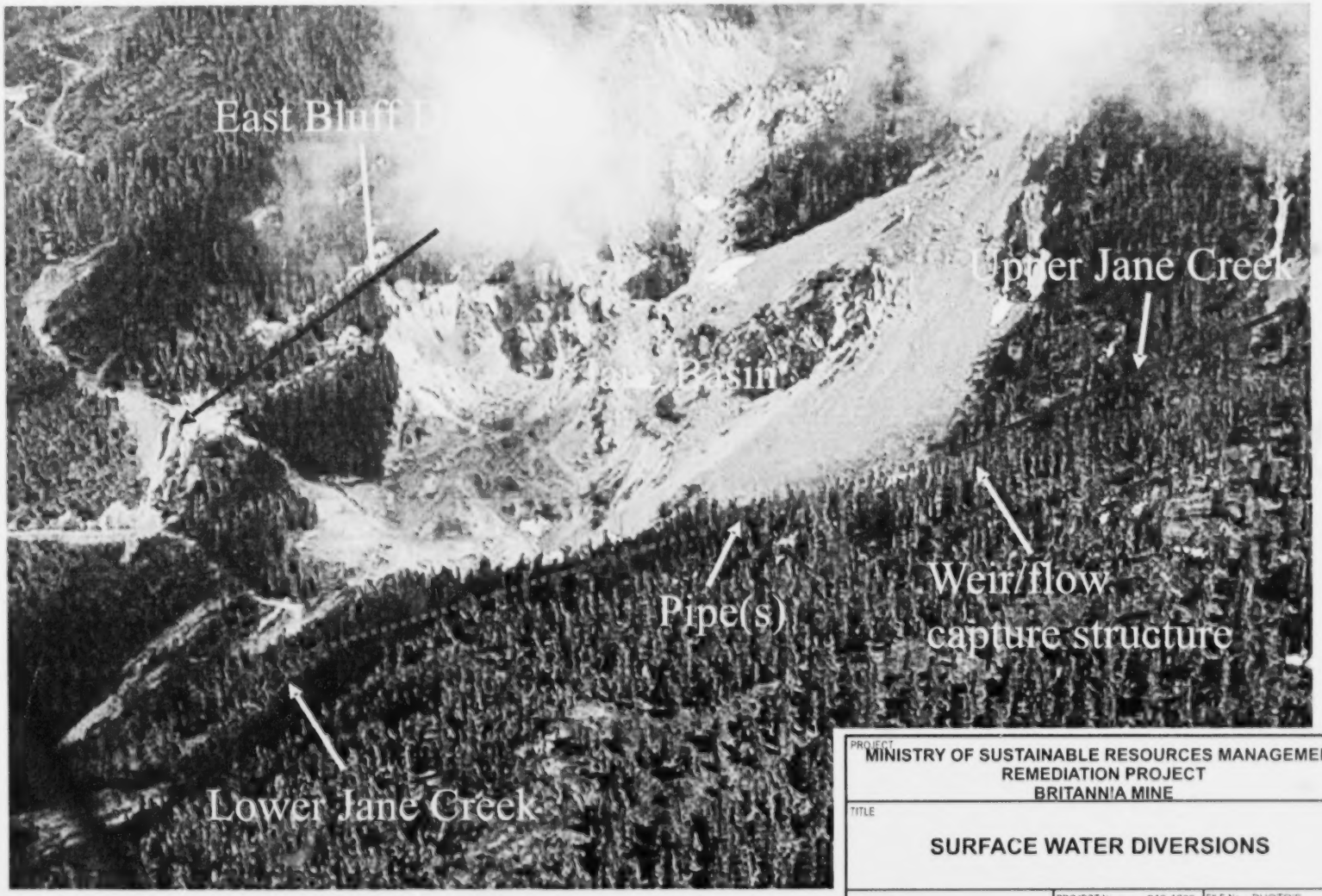
HAULED VOLUME SUMMARY

4100 Level	5,230.5 m^3
WTP Road	1,040.0 m^3
Ore Bin	11,872.0 m^3
Bunker	752.0 m^3
Sedimentation Pond	3,376.0 m^3
4100 Borrow Pit Strip	4,656.0 m^3
Settling Pond/Fan Area	2,064.0 m^3
TOTAL HAULED	**28,990.5 m^3**

FIGURE 5
MATERIAL HAULAGE TO JANE BASIN



DRAWING DATE: 28-Dec-04 COREL FILE: N:\Bur-Graphics\Projects\1800\2001\012-1830\Drafting\corel\Photo's.cdr



PROJECT
MINISTRY OF SUSTAINABLE RESOURCES MANAGEMENT
REMEDIATION PROJECT
BRITANNIA MINE

TITLE
SURFACE WATER DIVERSIONS

Golder Associates

PROJECT No.		012-1830	FILE No. PHOTO'S	
DESIGN	CC	27DEC04	SCALE	REV.
CADD	SS	27DEC04	FIGURE 6	
CHECK	CC	27DEC04		
REVIEW				

APPENDIX I

JANE BASIN DISPOSAL PERMIT (PR-17488) AND AMENDMENT

BRITISH COLUMBIA

REGISTERED MAIL

JUN 2 4 2004

Site: 436
Permit No: PR-17488

Government of British Columbia
c/o Brian Clarke
Director, Contaminated Site Management
Ministry of Sustainable Resources Management
PO Box 9361 Stn Prov Govt
Victoria BC V8W 9M2

Dear Brian:

Re: Jane Basin Disposal Permit PR-17488, Britannia Mine Site, B.C.

Please find attached Disposal Permit PR-17488 for the disposal of historic mine wastes from Britannia Beach to a controlled disposal facility in Jane Basin on the Britannia Mine Site. The permit is issued in response to your application of September 2, 2003 which appears on the Ministry of Sustainable Resources Management's dedicated web site at:
http://srmwww.gov.bc.ca/clrg/britannia/downloads/reports/letters_to_reg/refuse_application.pdf
and on the basis of supporting technical information provided in the *Jane Basin Disposal Permit Application #PR-14788 Technical Assessment Report, Britannia Mine Remediation Project, Britannia Beach, BC.*, May 12, 2004, ("Technical Assessment Report") prepared by Golder Associates, also located on the dedicated web site at:
http://srmwww.gov.bc.ca/clrg/britannia/downloads/reports/tech_reports/CSIR_jane_basin_contam_soil_disposal_permit.pdf

The application and supporting technical report were distributed for comment to members of the Britannia Remediation Project Stakeholder Distribution List and to local agency representatives as well as being made publicly available on the Ministry of Sustainable Resources Management's web site.

No comments have been received from stakeholders or members of the public on the subject application or supporting documentation.

Ministry of Water, Land and Air Protection
Office of the Assistant Deputy Minister
Mailing Address: PO Box 9339 Stn Prov Govt Victoria BC V8W 9M1
Location: 5th Floor, 2975 Jutland Road Victoria BC

The relocation and disposal of mine wastes in Jane Basin for which the permit has been issued is being carried out as part of the Britannia Mine Remediation Project and is described in the *Overall Mine Closure and Site Remediation Plan, Britannia Mine, Britannia Beach, BC,* October 8, 2003, prepared by Golder Associates Ltd ("Overall Remediation Plan") and in the aforementioned Technical Assessment Report.

The objective and rationale for the requested disposal are provided in the May 12, 2004 Technical Assessment Report:

> The objective of the soil/rock relocation project is to remove material from locations where it has a high risk of adversely affecting the environment to one where this risk is much reduced. The materials in question contain elevated concentrations of heavy metals, and have the potential to generate acidic leachate. The placement of these fills in Jane Basin will facilitate the treatment of this leachate by directing it, via the existing mine workings, to a deep outfall in Howe Sound and once constructed (2005), to a water treatment plant. (page i)

On the potential environmental impacts the report states:

> Based on the available information, it is considered that the placement of 15,000 m^3 of acid generating material in Jane Basin will not significantly affect the existing environment in Jane Basin, and the increase in contaminant loading at the effluent discharge point [from the 4100 portal of the mine] will be negligible. (page ii)

Operational procedures and environmental controls to be employed during relocation and disposal are described in the report as follows:

> The relocation process will be initiated by the reactivation of the access road leading to Jane Basin. Next, an estimated volume of 15,000 m^3 of soil and rock currently situated at various locations within the Britannia Mine property will be transported to Jane Basin during summer, 2004. As material arrives at Jane Basin it will be placed into the East Bluff Glory Hole and Open Pit areas (capacity > 100,000 m^3) in a controlled fashion using a bulldozer. With over half of the material being ore that originated from within Jane Basin, the bulk acid generating properties of the material are similar to the in-situ bedrock exposed by mining activities, into which they will be placed.

> The facility will produce a metal-contaminated, acidic leachate discharge to the existing mine workings. Surface drainage intrastructure in Jane Basin will prevent discharges of leachate to surface water and will direct clean incident water away from the placed materials to reduce leachate production. There is also some potential for generating fugitive dust during material placement operations, which will be minimized through wetting of fine material as necessary during placement. (page i)

The authorised period of disposal will run from June 28, 2004 to October 31, 2004. This disposal period is within that provided in the October 8, 2003 Overall Remediation Plan for this activity and reflects consideration of a reasonable work window for the completion of materials disposal, construction of surface water diversions and site closure in 2004.

In issuing Disposal Permit PR-17488 I have considered both the necessity of the requested disposal to the advancement of the remediation of the Britannia Mine Site and the appropriateness of the disposal activity as described and rationalized in supporting technical reports. I have also considered the absence of concerns expressed by stakeholders, including other federal and provincial regulatory agencies, local District and First Nation's representatives and the residents of Britannia Beach. It is my view that the permit is necessary and appropriate, subject to specified conditions.

This decision may be appealed to the Environmental Appeal Board. Notice of the appeal must (1) be in writing, (2) include the grounds for appeal, (3) be directed by registered mail or personally delivered to the Chair, Environmental Appeal Board, 4th Floor 836 Yates Street, Victoria British Columbia V8V 1X4, (4) be delivered within 30 days from the date notice of the decision is given, and (5) be accompanied by a fee of $25, payable to the Minister of Finance and Corporate Relations. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

Plans and reports prepared under the permit should be submitted to me and copied to Peggy Evans, Senior Contaminated Sites Officer. Copies should be made available to stakeholder representatives on the Britannia Mine Remediation Distribution List through posting to the Ministry of Sustainable Resources Management's dedicated web site and e-mail notification or by mail or fax.

Any questions in connection with the Disposal Permit should be directed to Peggy Evans at (250) 356-8386 or Peggy.Evans@gems3.gov.bc.ca.

Yours truly,

Eric Partridge
Director of Waste Management

cc: Distribution List

BRITISH COLUMBIA

MINISTRY OF WATER, LAND, AND AIR PROTECTION

Environmental Protection
2975 Jutland Rd
Victoria BC V8W 9M1
Telephone: (250) 387-1288
Fax: (250) 387-5669

PERMIT
PR-17488

Under the Provisions of the Waste Management Act

Her Majesty The Queen in Right of the Province of British Columbia as Represented by the Minister of Sustainable Resource Management

Parliament Buildings

Victoria, British Columbia V8V 1X4

is authorized to deposit metal contaminated soil and rock from the area of Britannia Beach and surrounding slopes to a disposal site at Jane Basin, all located on the historic Britannia Mine Site, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Waste Management Act* and may result in prosecution.

1. AUTHORIZED WASTE DEPOSIT

1.1. This section applies to the deposit of metal contaminated soil in Jane Basin as part of the Britannia Mine Remediation Project and as described in the *Jane Basin Disposal Permit Application #PR-14788 Technical Assessment Report, Britannia Mine Remediation Project, Britannia Beach, BC.*, prepared by Golder Associates Ltd, May 12, 2004.

1.1.1 The locations from which the deposit material originates are the Britannia Beach Fan, Mill slope/ore bins and 4100 level bench all located on the historic Britannia Mine Site, Britannia Beach, BC within PID 015-914-887, District Lot 892, Group 1 New Westminster District.

1.1.2 The location of the disposal site is East Bluff Glory Hole, Jane Basin, Britannia Mine Site, BC within PID 015-914-887, District Lot 1892, Group 1 New Westminster District as shown on Site Plan A.

1.1.3 The characteristics of the deposit material are metal contaminated soil including mineral soil, settling pond sludge, tailings, waste rock and concentrate that were deposited as part of historic mining activity at the Britannia Mine. The deposit materials are not classified as Special Waste on the basis of analytical testing. Minor amounts of hydrocarbon contaminated materials may be included.

Date Issued: JUN 2 4 2004
Date Amended: _____
(most recent)

Eric Partridge
Director of Waste Management

PROVINCE OF
BRITISH COLUMBIA

1.1.4 The authorized disposal facility is located entirely within the open pit of the East Bluff Glory Hole in Jane Basin. All drainage from the disposal site shall be directed into the glory hole and underground workings of Britannia Mine as authorized under Item 2.2 below. The waters of the Britannia Mine currently discharge by way of the 4100 portal and a deep outfall into Howe Sound. Following the construction of a water treatment plant in 2005, authorized under discharge permit PE-17469 (in draft, March 30, 2004), discharge water from the 4100 portal will be treated prior to discharge to the Sound.

1.1.5 The deposit material shall be transported to the disposal site by way of an access road authorized separately under permits of the *Ministry of Energy and Mines* and *Ministry of Forests*.

1.1.6 The authorized period of transfer and deposit is from June 28, 2004 to October 31, 2004.

1.1.7 The maximum authorized deposit volume is 15,000 cubic metres.

1.1.8 At the completion of disposal activities the authorized facility shall be closed in accordance with procedures outlined in the *Technical Assessment Report* and under Item 2.5 below.

2. GENERAL REQUIREMENTS

2.1. Operations and Maintenance

The disposal facility shall be operated and maintained in accordance with procedures outlined in the May 2004 *Technical Assessment Report* (Sections 2.4 and 2.5) including and in particular adherence to safety and environmental risk management procedures described under Section 2.5.4.

Any metal contaminated materials found to qualify as Special Waste during testing and transfer to the disposal facility shall be managed in accordance with the requirements of the Special Waste Regulation.

2.2. Water Management

All surface waters exposed to and draining through the deposit materials shall be directed into the glory hole and Britannia Mine. The diversion of clean surface water away from the deposit material and from naturally occurring metal contaminated rock in Jane Basin shall be carried out as part of the *Overall Mine Closure and Site Remediation Plan, Britannia Mine, Britannia Beach, BC,* prepared October 8, 2003 by Golder Associates (Section 6.2 – Mine Water Control, Storage and Collection) and shall be completed by October 31, 2004.

Date Issued: JUN 2 4 2004
Date Amended: _____
(most recent)

Eric Partridge
Director of Waste Management

PROVINCE OF
BRITISH COLUMBIA

2.3 **Emergency Procedures**

In the event of an emergency which prevents compliance with a requirement of this permit, that requirement shall be suspended for such time as the emergency continues or until otherwise directed by the Director of Waste Management or his delegate ("the Director") provided that:

(a) Due diligence was exercised in relation to the process, operation or event which caused the emergency and that the emergency occurred notwithstanding this exercise of due diligence;

(b) The Director is immediately notified of the emergency and of contingency actions invoked or planned to mitigate adverse impacts and restore compliance; and

(c) Due diligence is exercised in restoring compliance in the shortest possible time frame.

Notwithstanding (a), (b) and (c) above, the Director may specify contingency actions to be implemented to protect human health and the environment while authorised facility and/or standard operating procedures are being restored.

2.4 **Facility Modifications**

Changes in the authorised facility or operations and maintenance procedures that may adversely affect human health or the environment are prohibited unless authorised in writing by the Director.

2.5 **Site Closure**

Site closure shall be carried out to satisfy conditions described in Section 2.3.3 of the May 2004 *Technical Assessment Report*.

A closure report shall be submitted to the Director 60 days after the completion of disposal activities that includes, but is not limited to, the following items:

1) total volume (quantity) of soil and rock deposited;
2) final configuration and surface cover of disposal facility; and
3) location, as-built construction details and inspection and maintenance plans for surface water diversion ditches constructed to divert surface water away from the disposal facility.

Date Issued: JUN 2 4 2004
Date Amended: _____
(most recent)

Eric Partridge
Director of Waste Management

PROVINCE OF
BRITISH COLUMBIA

3. ENVIRONMENTAL MONITORING

Environmental monitoring to assess the environmental impacts of the disposal facility on Howe Sound shall be carried out under the separate monitoring requirements of discharge permit PE-17469 (in draft, March 30, 2004) issued in connection with the water treatment plant being installed to treat metal contaminated mine water discharging from the 4100 portal of the Britannia Mine. Additional monitoring of area creeks that may be affected by haulage of the deposit materials to the disposal facility will be carried out in accordance with procedures set out or proposed in the *Overall Mine Closure and Site Remediation Plan, Britannia Mine, Britannia Beach, BC.*

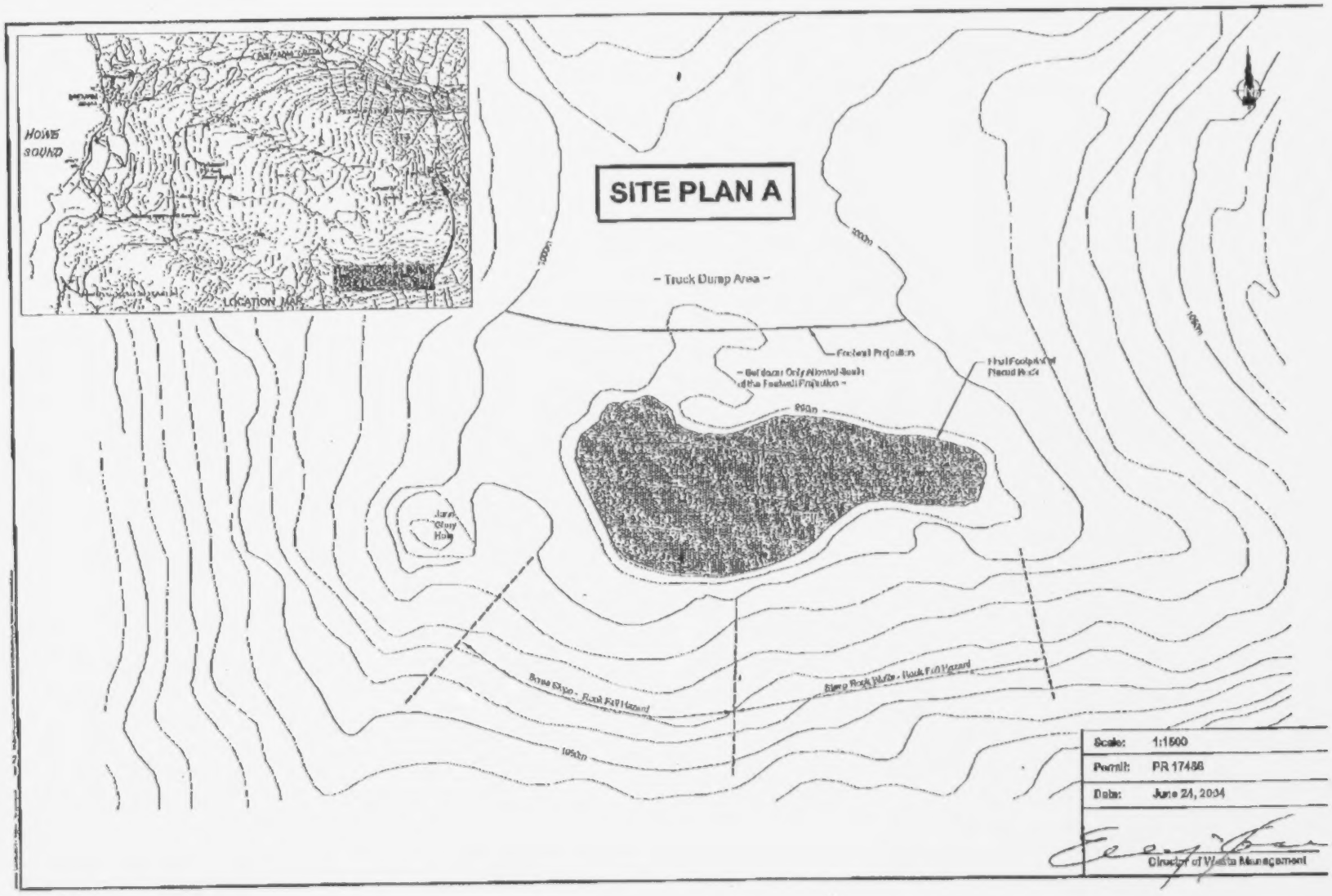
This permit is issued pursuant to the provisions of the *Waste Management Act* to ensure compliance with Section 54(3) of that statute, which makes it an offence to discharge waste to the environment without proper authorization.

This permit does not authorise entry upon, crossing over, or use for any purpose of private lands or works, unless and except as authorised by the owner of such lands or works. The responsibility for obtaining such authority rests with the permittee.

It is also the responsibility of the permittee to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other legislation that may apply in connection with the permitted activity.

Date Issued: JUN 2 4 2004
Date Amended: _____
(most recent)

Eric Partridge
Director of Waste Management


SITE PLAN A
HOWE SOUND
LOCATION MAP
- Truck Dump Area -
- Bedrock Only Allowed South of the Footwall Projection -
Footwall Projection
Hwy Rock Note - Rock Fall Hazard
Base Slope - Rock Fall Hazard
Scale: 1:1500
Permit: PR 17486
Date: June 24, 2004
Director of Waste Management

BRITISH COLUMBIA

BY FAX AND MAIL

SEP 2 2 2004

Site: 436
Permit No: PR-17488

Government of British Columbia
c/o Brian Clarke
Director, Contaminated Site Management
Ministry of Sustainable Resources Management
PO Box 9361 Stn Prov Govt
Victoria BC V8W 9M2

Dear Brian:

Re: Jane Basin Disposal Permit PR-17488, Britannia Mine Site, B.C.

Please find attached Disposal Permit PR-17488 as amended September 20, 2004. Amendments are as requested in the September 8, 2004 letter from Golder Associates (*Britannia Mine Site Remediation: Site 436, Jane Basin Disposal Permit PR-17488*) written on behalf of the Ministry of Sustainable Resources Management. Amendments have been made on the basis of the rationale and limitations provided in Golder's letter.

Amended clauses are as follows:

Clause 1.1.2: The location of the disposal site is amended to read "the open pit, including East Bluff Glory Hole, Jane Glory Hole and areas in between, of Jane Basin, Britannia Mine Site, BC..." Site Plan A is amended to incorporate the revised plan provided by Golder.

This amendment is accepted on the basis that "placed material would be such as to allow any leachate discharging from the materials to drain into either East Bluff or Jane Glory Holes and be addressed as in the technical information provided in the *Jane Basin Disposal Permit Application #PR-17488 Technical Assessment Report, Britannia Mine Remediation Project, Britannia Beach, BC*, dated May 12, 2004."

Ministry of Water, Land and Air Protection
Office of the Assistant Deputy Minister
Mailing Address: PO Box 9339 Stn Prov Govt Victoria BC V8W 9M1
Location: 5th Floor, 2975 Jutland Road Victoria BC

Clause 1.1.4: The location of the disposal facility is amended to be located entirely within the open pit of Jane Basis. All drainage shall be as directed in the June 24, 2004 permit and May 12, 2004 Technical Assessment Report.

Clause 1.1.6: The period of transfer is extended from October 31, 2004 to November 30, 2004 to allow for the transfer of additional material discussed below.

Clause 1.1.7: The maximum deposit volume authorized under the permit is increased from 15,000 cubic metres to 25,000 cubic metres. The additional volume of materials requiring disposal in Jane Basin is described in Golder's letter as:

- Substantial additional volumes of ore present in the ore bins above the 4100 level portal than projected in the May 12, 2004 Technical Report;
- Metal-contaminated soils from the construction site for the water treatment plant not included in the original volume estimate;
- Metal-contaminated soils from the historic copper launder settlement pond that were not fully removed during remediation completed by the former mine owner, Britannia Mine Reclamation Corp.; and
- Additional material from former mine site lands now owned by Britannia Bay Property Ltd., over and above the original estimate provided for this material.

Based on the May 12, 2004 Technical Report ample capacity exists within the Jane Basin open pit to allow for the additional requested disposal volume.

Any questions in connection with this amendment of the Disposal Permit should be directed to Peggy Evans at (250) 356-8386 or Peggy.Evans@gems3.gov.bc.ca.

Yours truly,

Eric Partridge
Deputy Director of Waste Management

cc: Distribution List

BRITISH COLUMBIA

MINISTRY OF WATER, LAND, AND AIR PROTECTION

Environmental Protection
2975 Jutland Rd
Victoria BC V8W 9P1
Telephone: (250) 387-1288
Fax: (250) 387-5669

PERMIT
PR-17488

Under the Provisions of the Environmental Management Act

Her Majesty The Queen in Right of the Province of British Columbia as Represented by the Minister of Sustainable Resource Management

Parliament Buildings

Victoria, British Columbia V8V 1X4

is authorized to deposit metal contaminated soil and rock from the area of Britannia Beach and surrounding slopes to a disposal site at Jane Basin, all located on the historic Britannia Mine Site, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

1. AUTHORIZED WASTE DEPOSIT

1.1. This section applies to the deposit of metal contaminated soil in Jane Basin as part of the Britannia Mine Remediation Project and as described in the *Jane Basin Disposal Permit Application #PR-14788 Technical Assessment Report, Britannia Mine Remediation Project, Britannia Beach, BC.*, prepared by Golder Associates Ltd, May 12, 2004.

1.1.1 The locations from which the deposit material originates are the Britannia Beach Fan, Mill slope/ore bins and 4100 level bench all located on the historic Britannia Mine Site, Britannia Beach, BC within PID 015-914-887, District Lot 892, Group 1 New Westminster District.

1.1.2 The location of the disposal site is the open pit, including East Bluff Glory Hole, Jane Glory Hole and areas in between, of Jane Basin, Britannia Mine Site, BC within PID 015-914-887, District Lot 1892, Group 1 New Westminster District as shown on Site Plan A.

1.1.3 The characteristics of the deposit material are metal contaminated soil including mineral soil, settling pond sludge, tailings, waste rock and concentrate that were deposited as part of historic mining activity at the Britannia Mine. The deposit materials are not classified as Special Waste on the basis of analytical testing. Minor amounts of hydrocarbon contaminated materials may be included.

Date Issued: June 24, 2004
Date Amended: SEP 22 2004
(most recent)

Eric Partridge
Deputy Director of Waste Management

SEP 22 '04 14:02 250 763 2636 PAGE.04

1.1.4 The authorized disposal facility is located entirely within the open pit of Jane Basin. All drainage from the disposal site shall be directed into the glory hole and underground workings of Britannia Mine as authorized under Item 2.2 below. The waters of the Britannia Mine currently discharge by way of the 4100 portal and a deep outfall into Howe Sound. Following the construction of a water treatment plant in 2005, authorized under discharge permit PE-17469 (in draft, March 30, 2004), discharge water from the 4100 portal will be treated prior to discharge to the Sound.

1.1.5 The deposit material shall be transported to the disposal site by way of an access road authorized separately under permits of the *Ministry of Energy and Mines* and *Ministry of Forests*.

1.1.6 The authorized period of transfer and deposit is from June 28, 2004 to November 30, 2004.

1.1.7 The maximum authorized deposit volume is 25,000 cubic metres.

1.1.8 At the completion of disposal activities the authorized facility shall be closed in accordance with procedures outlined in the *Technical Assessment Report* and under Item 2.5 below.

2. GENERAL REQUIREMENTS

2.1. Operations and Maintenance

The disposal facility shall be operated and maintained in accordance with procedures outlined in the May 2004 *Technical Assessment Report* (Sections 2.4 and 2.5) including and in particular adherence to safety and environmental risk management procedures described under Section 2.5.4.

Any metal contaminated materials found to qualify as Special Waste during testing and transfer to the disposal facility shall be managed in accordance with the requirements of the Special Waste Regulation.

2.2. Water Management

All surface waters exposed to and draining through the deposit materials shall be directed into the glory hole and Britannia Mine. The diversion of clean surface water away from the deposit material and from naturally occurring metal contaminated rock in Jane Basin shall be carried out as part of the *Overall Mine Closure and Site Remediation Plan, Britannia Mine, Britannia Beach, BC*, prepared October 8, 2003 by Golder Associates (Section 6.2 – Mine Water Control, Storage and Collection) and shall be completed by October 31, 2004.

Date Issued: June 24, 2004
Date Amended: (most recent) SEP 22 2004

Eric Partridge
Deputy Director of Waste Management

SEP 22 '04 14:02 250 763 2636 PAGE.05

2.3 **Emergency Procedures**

In the event of an emergency which prevents compliance with a requirement of this permit, that requirement shall be suspended for such time as the emergency continues or until otherwise directed by the Director of Waste Management or his delegate ("the Director") provided that:

(a) Due diligence was exercised in relation to the process, operation or event which caused the emergency and that the emergency occurred notwithstanding this exercise of due diligence;

(b) The Director is immediately notified of the emergency and of contingency actions invoked or planned to mitigate adverse impacts and restore compliance; and

(c) Due diligence is exercised in restoring compliance in the shortest possible time frame.

Notwithstanding (a), (b) and (c) above, the Director may specify contingency actions to be implemented to protect human health and the environment while authorised facility and/or standard operating procedures are being restored.

2.4 **Facility Modifications**

Changes in the authorised facility or operations and maintenance procedures that may adversely affect human health or the environment are prohibited unless authorised in writing by the Director.

2.5 **Site Closure**

Site closure shall be carried out to satisfy conditions described in Section 2.3.3 of the May 2004 *Technical Assessment Report.*

A closure report shall be submitted to the Director 60 days after the completion of disposal activities that includes, but is not limited to, the following items:

1) total volume (quantity) of soil and rock deposited;
2) final configuration and surface cover of disposal facility; and
3) location, as-built construction details and inspection and maintenance plans for surface water diversion ditches constructed to divert surface water away from the disposal facility.

Date Issued: June 24, 2004
Date Amended: SEP 22 2004
(most recent)

Eric Partridge
Deputy Director of Waste Management

SEP 22 '04 14:20 250 763 2636 PAGE.06

3. ENVIRONMENTAL MONITORING

Environmental monitoring to assess the environmental impacts of the disposal facility on Howe Sound shall be carried out under the separate monitoring requirements of discharge permit PE-17469 (in draft, March 30, 2004) issued in connection with the water treatment plant being installed to treat metal contaminated mine water discharging from the 4100 portal of the Britannia Mine. Additional monitoring of area creeks that may be affected by haulage of the deposit materials to the disposal facility will be carried out in accordance with procedures set out or proposed in the *Overall Mine Closure and Site Remediation Plan, Britannia Mine, Britannia Beach, BC.*

This permit is issued pursuant to the provisions of the *Waste Management Act* to ensure compliance with Section 54(3) of that statute, which makes it an offence to discharge waste to the environment without proper authorization.

This permit does not authorise entry upon, crossing over, or use for any purpose of private lands or works, unless and except as authorised by the owner of such lands or works. The responsibility for obtaining such authority rests with the permittee.

It is also the responsibility of the permittee to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other legislation that may apply in connection with the permitted activity.

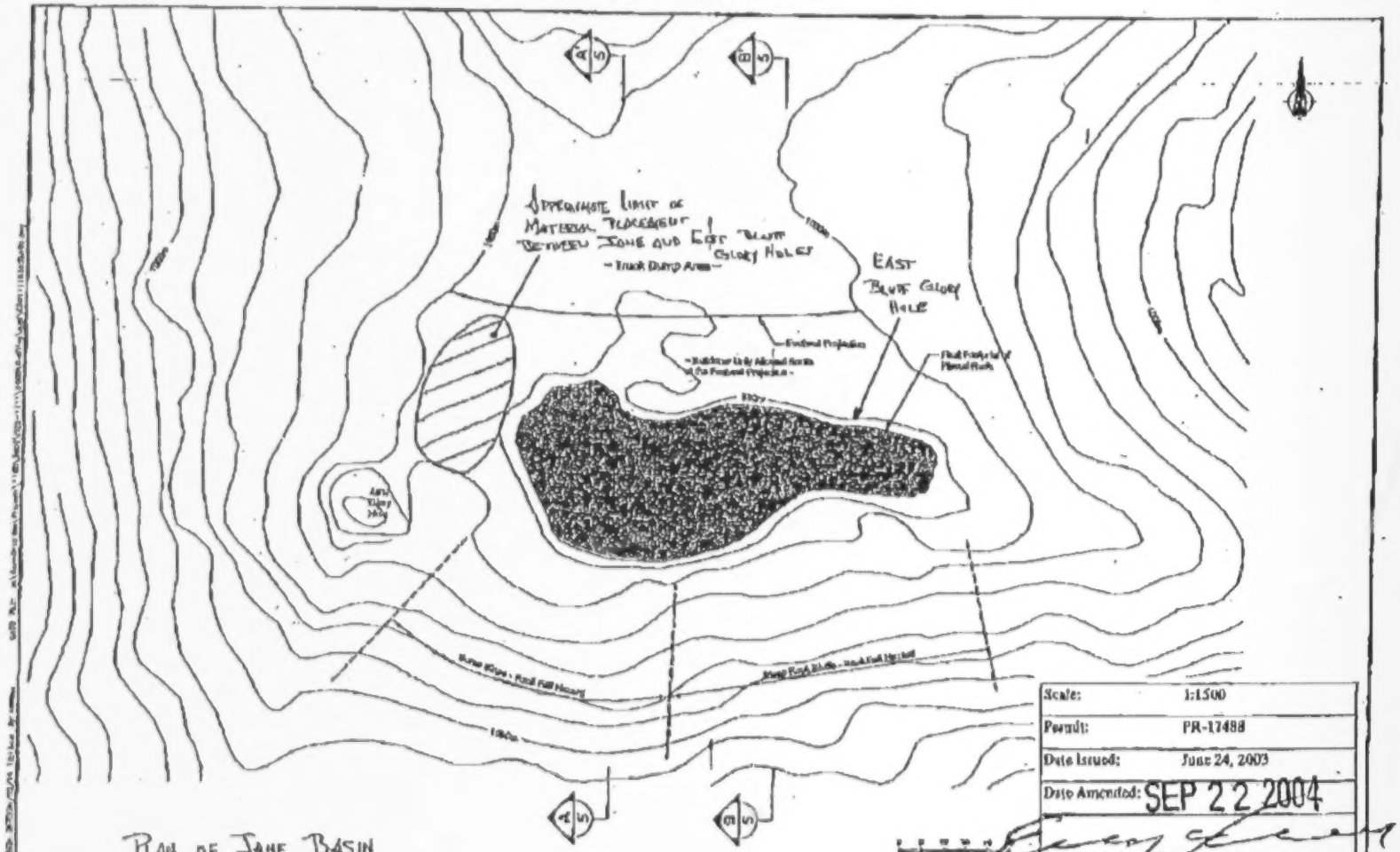
Date Issued: June 24, 2004
Date Amended: SEP 22 2004
(most recent)

Eric Partridge
Deputy Director of Waste Management

SEP 22 '04 14:01 250 763 2636 PAGE.07

SEP 22 '24 14:21 252 763 2536 PAGE.02

SITE PLAN A


APPROXIMATE LIMIT OF MATERIAL PLACEMENT BETWEEN ZONE AND EAST BLUFF GLORY HOLE
- Truck Dump Area -
EAST BLUFF GLORY HOLE
- Footwall Projection -
- Backfill only Allowed North of the Footwall Projection -
Scale: 1:1500
Permit: PR-17488
Date Issued: June 24, 2003
Date Amended: SEP 22 2004
Deputy Director of Waste Management

PLAN OF IANE BASIN